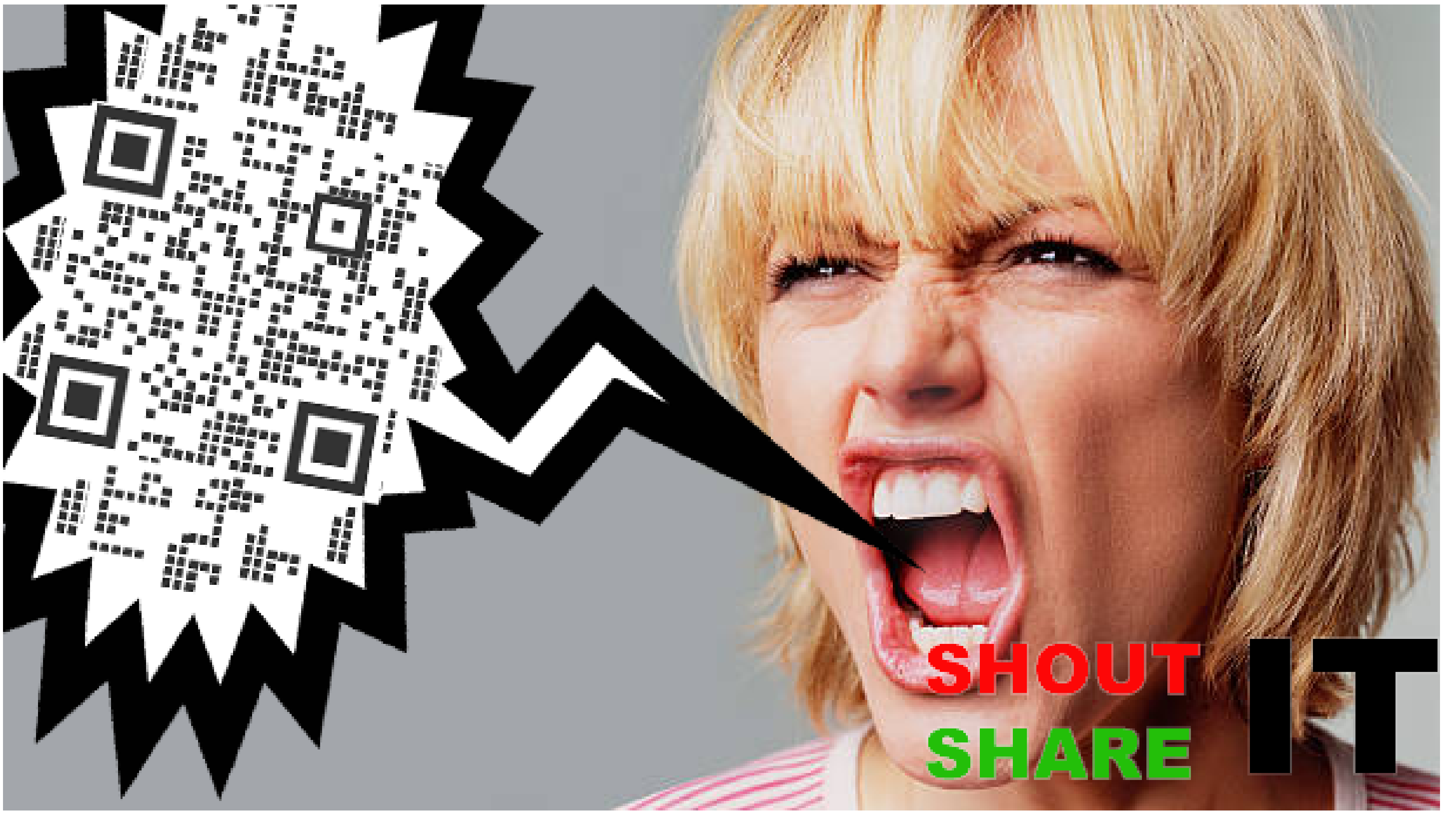
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LETTER OF TRANSMITTAL.

Department of the Interior,
U. S. Geological Survey,
Geographic Branch,
Washington, D. C., May 17, 1892.

Sir: I have the honor to submit herewith for publication a manual of the topographic methods in use by the Geological Survey, accompanied by a collection of constants and tables used in the reduction of astronomical observations for position, of triangulation, of height measurements, and other operations connected with the making of topographic maps. It must be understood that the methods are not fixed, but are subject to change and development, and that this manual describes the stage of development reached at present.

In the preparation of this work I have to acknowledge the aid of many of my associates, notably Mr. H. M. Wilson and Mr. S. S. Gannett. To Mr. R. S. Woodward, now connected with the U. S. Coast and Geodetic Survey, I am indebted for the "Instructions for the Measurement of Horizontal Angles" in Chapter III. These instructions, which were drawn up by Mr. Woodward several years ago for the guidance of field parties engaged in primary triangulation, have resulted in a great increase in accuracy and considerable economy of time and labor. To Messrs. G. K. Gilbert and W. J. McGee I am indebted for their kindly criticism, especially concerning the chapter upon the "Origin of Topographic Features."

Some of the tables have been prepared in this office; others have been compiled from various sources, notably from appendices to reports of the U. S. Coast and Geodetic Survey and "Lee's Tables and Formulæ."

Very respectfully,

HENRY GANNETT,
Chief Topographer.

Hon. J. W. POWELL,
Director U. S. Geological Survey.

A MANUAL OF TOPOGRAPHIC METHODS.

By Henry Gannett.

CHAPTER I.

INTRODUCTION.

The object of this manual is to present a description of the topographic work, instruments, and methods used by the U. S. Geological Survey, primarily for the information of the men engaged upon this work. It is not intended as an elementary treatise upon surveying, as it presupposes a knowledge of the application of mathematics to surveying equivalent to that to be obtained in our professional schools. Neither is it intended as a general treatise on topographic work, although it may, to a certain extent, supply the existing need of such a work.

The Geological Survey is engaged in making a topographic map of the United States. Excepting for certain areas, lying mainly in the far West, there existed, prior to the inception of this work, no maps upon a sufficiently large scale and in suitable form for the use of the geologist. While the primary object of the map is to meet the needs of the geologists of the Survey, it has been thought economical to adjust the plans so that the resulting map may be adequate to serve all needs for which general topographic maps are used.

Certain areas, especially in the far West, have been surveyed and mapped by other organizations, notably those of the general and state governments, upon a sufficiently large scale, and with sufficient accuracy for the use of the Geological Survey; much material also exists in the form of triangulation, of lines of levels, and of other partial surveys which can be put to use and will assist to a greater or less extent in the preparation of the map. These maps and other material have been, or may be, adopted by the Geological Survey. Their extent is represented upon the accompanying map, Pl. I, as fully as possible, and they are enumerated, with a brief description, as follows:

SURVEYS UNDER THE UNITED STATES GOVERNMENT.

The Survey of the Fortieth Parallel, from 1867 to 1872, under Mr. Clarence King, embraced a zone of country 105 miles in breadth, extending from the meridian of 104° to that of 120° west of Greenwich, and comprising an area of 87,000 square miles. The maps were made upon a scale of 4 miles to an inch, with contours having a vertical interval of 300 feet. The work was controlled by triangulation, resting primarily upon a base line measured by determining astronomically the latitudes of two points, and the azimuth of the line connecting them; and, secondarily, upon a base line extending nearly from the eastern to the western limits of the work, the coordinates of the ends of which were determined astronomically, the latitude by zenith telescope and the longitude by telegraphic time comparisons. Primary triangulation was done with theodolites reading to ten seconds. Secondary triangulation and location were executed with minute reading instruments, and topography was sketched and afterwards transferred to the platted framework. Heights were measured by barometer and the vertical arc.

The Geological and Geographical Survey of the Territories, under Dr. F. V. Hayden, between 1873 and 1878, surveyed areas in Colorado, New Mexico, Utah, Wyoming, Idaho, in all about 100,000 square miles. The maps were published upon a scale of 4 miles to an inch, with a contour interval of 200 feet. The base lines for the control of this work were measured with steel tapes, under uniform tension, and with corrections for temperature. Triangulation was carried on with 8-inch theodolites reading to ten seconds, and was adjusted by a graphic method. Secondary triangulation, the location of topographic details, and the measurement of heights were effected by methods quite similar to those employed by the Survey of the Fortieth Parallel.

The Survey of the Rocky Mountain Region, under Maj. J. W. Powell, embraced an area of about 60,000 square miles, covering parts of Wyoming, Utah, and Arizona. This work was done between 1869 and 1877. The maps were drawn upon a scale of 4 miles to an inch, with contour intervals of 250 feet. The work was controlled by triangulation from base lines measured with wooden rods. It was carried on with a theodolite having a 10-inch circle reading by vernier to ten seconds, and was adjusted by the method of least squares. Secondary triangulation was done with minute reading instruments, and minor locations, together with topographic details, were obtained by the use of the plane table. Heights were measured by the barometer, supplemented by the vertical circle.

The Northern Transcontinental Survey, an organization instituted by the Northern Pacific railroad company for the survey and examination of its lands, mapped, during the years 1882 and 1883, areas in Montana, Idaho, and Washington, aggregating about 43,000 square miles. These maps were intended for publication upon a scale of 4 miles to an inch, with contours having vertical intervals of 200 feet. The work was based upon triangulation, which was executed mainly with a theodolite having a circle 8 inches in diameter reading by vernier to ten seconds. The triangulation was adjusted graphically. The topographic methods were quite similar to those of the Hayden Survey.

The U. S. Coast and Geodetic Survey has covered the greater part of the Atlantic, Gulf, and Pacific coasts with triangulation, and with a narrow strip of topographic work. This strip is of variable width, depending largely upon the configuration of the coast, being, as a rule, narrow where the coast is simple, and broad where it is complex. Altogether an area of nearly 40,000 square miles has been surveyed, the original sheets being upon a scale of 1:10000 or 1:20000, the contours having vertical intervals of 20 feet. Most of this work is directly available as finished work. Upon some of it, however, the contours, owing to the great age of the original maps, have been obliterated, and it becomes necessary to resurvey this element. In addition to its coast work, the geodetic work of this organization has been extended into the interior in various directions, especially in New England, and along the eastern border of the Appalachian Mountain system, through the states of New York, New Jersey, Pennsylvania, Maryland, Virginia, West Virginia, North Carolina, Tennessee, Georgia, and Alabama. The work of connecting the Atlantic and Pacific coasts has been carried far toward completion, a belt having been extended westward from the head of Chesapeake Bay into central Kansas. A base has been measured near Colorado Springs, Colorado, and work has been extended thence eastward to the east boundary of the state, while from the Pacific coast triangulation has been brought eastward across California, Nevada and Utah.

In assisting the state surveys, the Coast and Geodetic Survey has, moreover, done a considerable amount of triangulation in the states of Massachusetts, New York, New Jersey, Pennsylvania, Kentucky, Tennessee, and Wisconsin.

The United States Lake Survey has mapped the shores of the Great lakes, carrying triangulation around them, and connecting the head of Lake Michigan with the foot of Lake Erie. A belt of triangulation has also been carried from the neighborhood of Vincennes, Indiana, northward along the eastern border of Illinois, connecting with the triangulation on the shore of Lake Michigan.

The Engineer Corps, U. S. Army, has completed a number of small pieces of topographic work in different parts of the country, and is now engaged in mapping the course of the Mississippi and Missouri rivers, controlling the work by geodetic methods.

The surveys of the General Land Office have extended over an area of about a million and a half square miles, and plats have been prepared representing the drainage of this entire area. The quality of this work is of varying degrees of excellence, but from its inception in the early part of the century its quality has improved greatly. Most of this work can be utilized either directly or indirectly by methods to be detailed hereafter.

SURVEYS UNDER STATE GOVERNMENTS.

Massachusetts.—Between 1830 and 1842, the state of Massachusetts carried on what was for the time an elaborate system of triangulation, known as the Borden Survey. By this organization numerous points, in the aggregate several hundred, were determined within the limits of the state. Subsequently, many of these points were redetermined by the Coast and Geodetic Survey, by more elaborate methods, thus furnishing what served substantially as a primary system of triangulation within which and to which the Borden work has been adjusted. As thus adjusted, the Borden locations are sufficiently accurate for the ordinary needs of map work upon the scale of one mile to an inch.

New York.—For several years, terminating in 1885, the state of New York supported a survey which was devoted to the geodetic location of points within its area. The work was of a high grade, comparing favorably with that of the Coast and Geodetic and Lake Surveys.

For many years also, the same state supported what was known as the Adirondack Survey, which was engaged mainly in a triangulation of the Adirondack region. Of this work few results have been published.

New Jersey.—In the year 1875, the state of New Jersey instituted a topographic survey of its area. The plan of the work contemplated a map upon a publication scale of one mile to an inch, with contours at vertical intervals ranging from 5 to 20 feet. Control of the work was furnished in part by the triangulation of the Coast and Geodetic Survey and in part by triangulation of its own. In July, 1884, the completion of that state was undertaken by the U. S. Geological Survey, by which organization it was pushed forward to a conclusion in 1887.

Pennsylvania.—In Pennsylvania considerable topographic work has been done by the State Geological Survey. This work is of a local character and confined to small areas, which have been mapped upon large scales, and the aggregate area is not large. It was carried on by traverse by the use of stadia and level.

RAILROAD AND OTHER SURVEYS.

Besides the material above enumerated, there exist in various parts of the country maps in great number and of varying quality. They consist of town and county maps, mainly made by traversing roads with odometer and compass, of railroad lines, executed in the ordinary manner by transit and chain, the surveys of the boundaries of the states and territories, etc. Some of this material may prove of service.

In addition to the material enumerated above, numerous astronomic determinations of position have been made by governmental organizations and by private parties. These positions, scattered over the interior, will, as far as they go, relieve the Geological Survey from carrying on this expensive work.

In addition to all this material, the railroads of the country furnish, in their profiles, a vast body of measurements of height. These differ greatly in value, those of certain railroads, and generally those of the great systems, being of a high degree of accuracy, while others are worthless. The errors in these profiles are seldom in the leveling itself, but are due to the fact that a road is leveled in sections, the profile of each section being based upon an arbitrary datum point. Mistakes often occur in joining the profiles of the several sections, and in correcting them for differences in their datum points.

PLAN OF THE MAP OF THE UNITED STATES.

The field upon which the Geological Survey is at work is diversified. It comprises broad plains, some of which are densely covered with forests, while upon others trees are entirely absent. It contains high and rugged mountains, plateaus, and low, rolling hills. In some regions its topographic forms are upon a grand scale, while in others the entire surface is made up of an infinity of minute detail. Some parts of the country are densely populated, as much so as almost any region upon the surface of the globe, while great areas in other parts of the country are almost without settlement. Geologically, portions of the country are extremely complex, requiring, for the elucidation of geologic problems, maps in great detail, while other areas are simple in the extreme.

It is obvious that from this diversity of conditions, both natural and material, maps of different areas should differ in scale, and that with the difference in natural conditions and the difference in scale there must come differences in the methods of work employed. The system which is found to work to advantage in the high mountain regions of the west is more or less inapplicable to the low forested plains of the Mississippi valley and the Atlantic plain.

SCALE.

The scales which have finally been adopted for the publication of the map are 1:62500 or very nearly 1 mile to an inch, and 1:125000, or very nearly 2 miles to an inch.

When this work was commenced in 1882, three different scales were used for different parts of the country, depending upon the degree of complexity of the topography and the geological phenomena, upon the density of population and the importance of the region from an industrial point of view. These scales were 1:62500, 1:125000, and 1:250000. The maps as fast as produced have found extended use, not only among geologists, but in all sorts of industrial enterprises with which the surface of the ground is concerned, and have already become well nigh indispensable in the projection of railroads, water works, drainage works, systems of irrigation, and other similar industrial enterprises. Their extended use has developed a requirement for better maps; i. e., maps upon a larger scale and in greater detail. At one stage of its development this requirement was met by discontinuing all mapping upon the scale 1:250000, which it was recognized at that time was inadequate to the requirements. Since then the standard of the requirements has continued to rise and, consequently, the plan of the map has been enlarged by the extension of the areas mapped upon the scale of 1:62500, and a corresponding reduction of the areas to be mapped upon the scale of 1:125000. Meantime, however, large areas have been mapped upon the discarded scale, and the maps have been published and widely distributed. Such areas will be remapped for the larger scales only as special needs may arise.

The considerations which have determined the selection of the above scales are as follows: They are believed to be sufficiently large to represent with faithfulness all the details required to picture the country and show the proper relations of its features, and to make the map of the greatest possible service for industrial and scientific uses consistent with other requirements to be mentioned hereafter. These scales are sufficiently large to present the details of nearly all geological phenomena. The map represents the country in sufficient detail to admit of the selection upon it of general routes for railroads and other public works and to show the location of boundary lines in such way that their position may be recognized upon the ground. On the other hand, the scales are not so large as to prevent the representation upon a single sheet of a considerable area, so that the relations between different regions can be seen at a glance.

A map on a larger scale than this would require a greater time for its completion and a greater expense, and when one considers the fact that the map upon these scales of the entire United States, even excluding Alaska, will, at best, cost in the neighborhood of twenty million dollars and at the present rate of progress require fifty years for its completion, one scarcely feels inclined to increase the labor and expense without an excellent reason for so doing. There is yet another objection to increasing the scale beyond that absolutely necessary. To be of value, such a map must undergo revision at frequent intervals, in order to incorporate any changes in culture and possibly in natural features due to natural or artificial agencies. The larger the scale the more frequently such revision should be made, and hence the labor and expense of keeping a map up to date would be greatly increased.

In this matter the experience of the civilized nations of Europe, all of which have prepared topographic maps of more or less of their areas, while certain of them have mapped their entire areas several times, is of great service and points unmistakably in the direction of the adopted scales. The history of these nations in this matter presents a singular degree of uniformity. Their first maps were upon large scales, and upon them they attempted to represent all details of natural and artificial topography, even property lines, so that one set of maps would answer for all purposes. Experience of the difficulty and expense of keeping up such maps (without counting their original cost) has taught them that economy consists in the production of, not a single map, but a series of maps, each designed to serve a special purpose; one as a cadastral map, another as a military map, and another, and this the most important, as a general topographic map. It further taught that this topographic map should be on a comparatively small scale, and accordingly, as a rule, the maps of foreign countries are upon scales approximating one mile to an inch, a scale which is sufficient to show all topographic details of a general character, and serves all ordinary purposes. The following table presents the scales of the general topographic maps of various European countries:

Scales of topographic maps of European nations.

India	1:63360
Great Britain and Ireland	1:63360
Germany	1:100000
Austria-Hungary	1:75000
France	1:80000
Switzerland	1:25000 1:50000
Holland	1:25000
Spain	1:50000
Italy	1:100000
Sweden	1:100000
Russia	1:126000
Belgium	1:20000 1:40000
Denmark	1:40000
Norway	1:100000
Portugal	1:100000

CONTOUR INTERVAL.

The relief of the earth's surface is now represented upon maps almost entirely by contour lines or lines of equal elevation. Until a comparatively recent date this element, secondary in importance only to the horizontal element, or the plan, has been ignored.

The contour intervals which have been adopted for the map of the United States are as follows:

For the scale of 1:62500, the intervals range from 5 to 50 feet; for the scale of 1:125000, 10 to 100 feet, and, for the scale of 1:250000, the interval is 200 or 250 feet.

FEATURES REPRESENTED.

In this matter, the experience of European nations tends in the direction of reducing the number of features which should be placed upon the map. It has been decided, in the preparation of the map of the United States, to go even beyond the present practice of European nations in this regard and to limit the map to the representation of all natural features which are of sufficient magnitude to warrant representation upon the scale, and to confine the cultural features, that is, the artificial ones, to those which are of general or public importance, leaving out those which are private in their nature. Under this definition the map will represent cities, towns, and villages, roads and railroads and other means of communication (with the exception of private roads), bridges, ferries, tunnels, fords, canals and acequias and boundaries of civil divisions. Fences, property lines, private roads, and other objects of a kindred nature are not represented. The reasons for excluding private culture are apparent. They are, first, because such features are not of sufficient general interest to pay the cost of surveying or representing them; second, because they change rapidly, and, in order to keep the maps up to date, would require constant resurveys and republication, while if the map is not kept constantly up to date, it is misleading, and, third, their number and complexity confuse the map and render its more important features less intelligible.

SIZE OF SHEETS.

Atlas sheets are designed to be approximately of the same size, 17 5 inches in length by from 12 to 15 in breadth, depending upon the latitude, and all those of the same scale cover equal areas, expressed in units of latitude and longitude, that is, each sheet upon the 4-mile scale covers one degree of latitude by one degree of longitude; each sheet upon the 2-mile scale, 30 minutes of latitude and longitude, and each sheet upon the 1-mile scale, 15 minutes of latitude and longitude. The sheets are thus small enough to be conveniently handled, and, if bound, form an atlas of convenient size. From the fact that each sheet is either a full degree or a regular integral part of a degree, its position with relation to the adjacent sheets and to the area of the country is easy to discover.

GEOMETRIC CONTROL.

From the constructive point of view, a map is a sketch, corrected by locations. The work of making locations is geometric, that of sketching is artistic. This definition is applicable to all maps, whatever their quality or character. However numerous the locations may be, they form no part of the map itself, but serve only to correct the sketch, while the sketch supplies all the material of the map. The correctness of the map depends upon four elements: first, the accuracy of location; second, the number of locations per square inch of the map; third, their distribution; and, fourth, the quality of the sketching. It is in connection with the first of these elements that it seems desirable to define what constitutes accuracy. The greatest accuracy attainable is not always desirable, because it is not economic. The highest economy is in properly subordinating means to ends and it is not economic to execute triangulation of geodetic refinement for the control of maps upon small scales. The quality of the work should be such as to insure against errors of sufficient magnitude to appear upon the scale of publication. While the tendency of errors in triangulation is to balance one another, still they are liable to accumulate, and this liability must be guarded against by maintaining a somewhat higher degree of accuracy than would be required for the location of any one point. It is not difficult to meet this first condition of accuracy of the maps. The maximum allowable error of location may be set at one-hundredth of an inch upon the scale of publication. This admits of an error upon the ground not greater, on a scale of 1:62500, than 50 feet.

The second condition of correctness, that is, the number of locations necessary for the proper control of the work, is not easily defined. The requirements differ with the character of the country. A region of great detail and of abrupt features requires more control than one of great uniformity and gentle slopes and of large features, so that no general rule can be laid down. Furthermore, it depends upon the quality of the sketching; with indifferent sketching a greater number of locations is required in order to bring the map up to the requisite quality.

The following table presents a summary of the amount of control obtained during the field season of 1891 in the different fields of work in this survey. It is presented not as a type of what should be, but to show what has been done and also to illustrate the wide range in the amount of control brought about by the differences in the character of the country and methods of work.

Statistics of control, field season 1891.

	Northeast division, New England, New York, and Pennsylvania.	Southeast division, Appalachian region and Atlantic Plain.	Central division.			
			Wisconsin.	Illinois.	Kansas.	Arkansas.
Area surveyed, square miles	3,150	8,090	1,446	1,095	7,600	1,480
Triangulation stations	650	108	....	....	....	8
Number of square inches per station	4.7	18.7	....	....	....	46.3
Points located by triangulation	3,330	1,427	....	....	....	....
Triangulation stations and located points	3,980	1,530	....	....	....	....
Number of above locations per square inch	1.3	0.7	....	....	....	....
Number of miles traversed	4,460	12,269	....	....	....	2,360
Inches traversed per square inch	1.4	1.5	....	....	....	1.5
Number of traverse stations	29,150	113,500	....	....	....	20,760
Traverse stations per square inch	9.3	56.1	....	....	....	56.1
Total number of locations per square inch	10.6	56.8	....	....	....	56.1
Traverse stations per linear mile	6.5	9.2	....	....	....	8.8
Heights measured instrumentally	5,700	7,800	1,276	7.768	3,456	130
Heights measured by aneroid	23.886	48,880	4,034	....	13,100	9,690
Total number of measured heights	29,586	56,680	5,310	....	16,556	9,820
Heights per square inch	9.4	28.0	3.6	7.1	8.7	26.5

As the reader will observe, the amount of control of various sorts is given in the above table with reference to areas in square inches upon the map as published. It is given in these terms in order to eliminate from it the question of scale.

No statistics of horizontal control are given for the areas surveyed in Wisconsin, Illinois, and Kansas, because most of it is furnished by the surveys of the General Land Office, and therefore the presentation would be but a partial one.

There are two general methods for location of stations and of minor points for the correction of the sketch, the one by angular measurements (triangulation), the other by measurement of directions and distances, or what is known popularly as the traverse or meander method. In ordinary practice, work may be done by either of these two methods, or they may be used in conjunction. The former of the two methods may be carried on with the plane table, various forms of the theodolite, with a compass, or, indeed, with an angle-reading instrument. The latter method may be carried on with the same instruments, supplemented by various forms of odometers, chain, steel tape, stadia, etc., for the measurement of distance. The first method, whenever it can be used economically, is the most accurate, and is, as a rule, the most rapid, and the locations are likely to be of the greater service and distributed most uniformly. It can be used economically where the country presents more or less relief, and where points for location, either natural or artificial, exist in sufficient numbers and are well distributed. These conditions are satisfied almost everywhere in the western mountain regions, where mountain peaks, summits of hills, plateau points, buttes, etc., furnish an abundance of natural points for stations and locations. It can be used, to a considerable extent, though not with the same ease or economy in the Appalachian mountains; but in this region it is necessary to supplement it extensively by traverse lines, especially in tracing the courses of streams in the valleys. It can be used, too, in the hill country of New England, where objects of culture, such as churches, houses, etc., furnish an abundance of signals. On the other hand, throughout the whole extent of the Atlantic and the Gulf plains, where the country is level or nearly so, and is covered with forests, the traverse method of surveying must be resorted to. This is a country devoid of sharp natural objects, a country in which extended views can not be obtained. The only economical way, therefore, of proceeding, is, starting from some point located by the triangulation, to carry a line of stations, connected together by distance and direction measurements, until the line checks upon a second triangulation point. For many reasons, this method of obtaining locations is inferior to the former. It is inferior not only in accuracy, but in the facilities which, as carried out, it affords for sketching the country, and it should be so regarded, and should be adopted only when it becomes necessary, or when the former method can not be applied economically. For convenience, traverse lines are generally run along the roads or trails, and thus the best points for commanding views of the country are avoided rather than sought. Being practically confined to the roads, there is danger that the topographer neglects, in a greater or less measure, the areas lying between them. On account of the errors incident to running a traverse it is necessary that, in this class of work, frequent locations be made by triangulation for checking and thereby eliminating its errors.

The locations dealt with in the above table fall into one or the other of these two classes. Locations by triangulation are of much greater value than those by traverse. As a rule, they are selected points chosen because each controls positions in a certain area. On the other hand, traverse locations are not, as a rule, chosen for their control value, but only for intervisibility on roads. Furthermore, the great majority of traverse stations are of no service whatever beyond carrying the line forward, so that in estimating the total amount of control in a certain area where the control is made up in whole or in part of traverse lines, less weight should be given to them than to locations by triangulation.

The third element of accuracy, the distribution of locations, is a point concerning which it is equally difficult to speak definitely. Other things being equal, the distribution should be uniform over the area, but it will necessarily vary with the character of the surface. The accompanying diagram shows the amount and distribution of control in a typical piece of work. In general, in the mountain regions, locations by angular measurements are frequent and accompany the ranges or ridges, and such locations are few in number in the valleys, being supplemented there by traverses.

The fourth of the elements of the correctness of the map depends upon the artistic sense of the topographer, upon his ability to see things in their proper relation, and his facility in transferring his impressions to paper. This is by far the most important and the most difficult to meet.

The education of the topographer, therefore, consists of two parts—the mathematical and the artistic. The first may be acquired largely from books, and this book knowledge must be supplemented by practice in the field. The second, if not inherited, can be acquired only by long experience in the field, and by many can be acquired only imperfectly. In fact, the sketching makes the map, and, therefore, the sketching upon the Geological Survey is executed by the best topographer in the party, usually its chief, whenever it is practicable to do so.

BUCKHANNON, W. VA., SHEET.

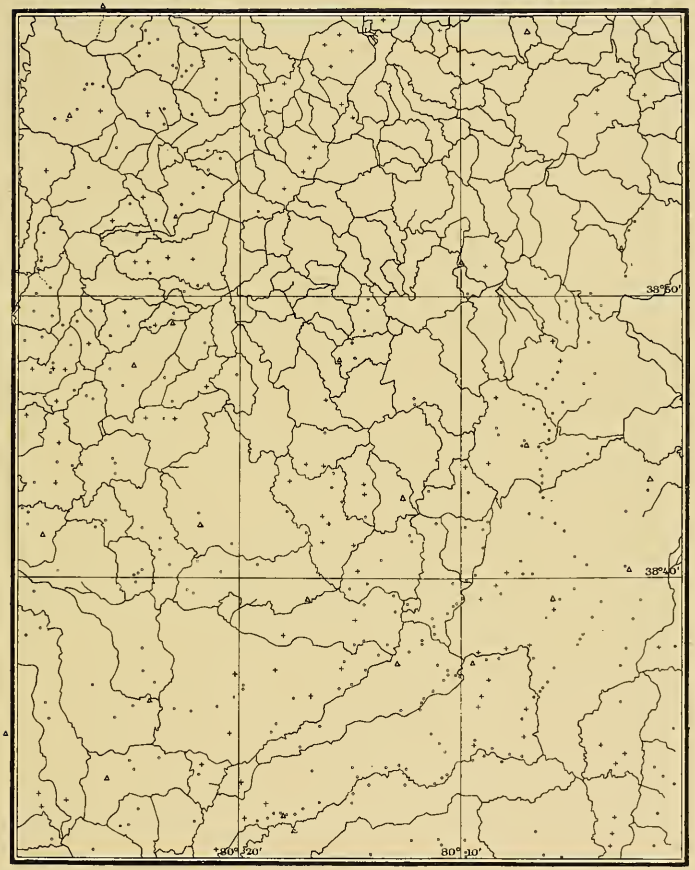


Diagram showing distribution of control work

Statute Miles

5 0 5 10

Main and Secondary stations .. ▲

Intersections from stations ......∘

Intersections from traverse .. +

Traversed Roads or Trails. ... ～

CHAPTER II.

CLASSIFICATION OF WORK.

The work involved in making a map usually comprises several operations, which may in practice be more or less distinct from one another. They are enumerated as follows:

First.—The location of the map upon the earth's surface, by means of astronomic observations.

Second.—The horizontal location of points.

This is usually of three grades of accuracy, primary triangulation, or primary traverse, in cases where triangulation is not feasible; secondary triangulation for the location of numerous points within the primary triangulation; and ordinary traverse, for the location of details.

Third.—The measurement of heights, which usually accompanies the horizontal location, and which may, similarly, be divided into three classes, in accordance with the degree of accuracy.

Fourth.—The sketching of the map.

Nearly all of the geometric work of the Survey, the work of location, is executed by five instruments.

Theodolites, of a powerful and compact form, used in the primary control.

Plane tables, with telescopic alidades of the best type, used for secondary triangulation and height measurements.

Plane tables, of crude, simple form, with ruler alidades, used for traversing and minor triangulation.

Odometers, for measuring distance.

Aneroids, for the measurement of details of heights.

With these instruments nine-tenths of the work is done, and these instruments will be described in their proper places with such fullness of detail as seems necessary.

Other instruments, such as transits, surveyors' theodolities, compasses, wye levels, hand and Abney levels, telemeters, chains, tapes, and mercurial barometers, are occasionally used. Most of these instruments, which are commonly figured and described in all works on surveying, are assumed to be well known to the readers of this manual and will therefore receive no special attention.

ASTRONOMIC DETERMINATIONS OF POSITION.

The object of astronomic determinations of position is to locate the map upon the earth's surface. They are made also for the purpose of checking and correcting positions determined by primary triangulation and primary traverse.

With regard to the checking of the primary triangulation by astronomic determinations, it should be understood that in the case of a single determination the work by triangulation is far more accurate than by astronomic determinations, even when made under the best of circumstances. It is, therefore, desirable to introduce checks of this kind upon primary triangulation only when the latter has been carried for a long distance, 200 or 300 miles, for instance, in the course of which it may have accumulated errors greater than those incident to astronomic work.

The case is different with primary traverse. The great number of courses required in this work affords an opportunity for the accumulation of error much greater than is the case with triangulation, and consequently it is desirable to introduce more frequent checks in this work. It may be said that, in general, such work should be checked at every 100 miles.

As was suggested above, the best astronomic determinations are none too good for the control of maps. Indeed, certain errors incident to this work, some of which as yet can not be corrected, may be of magnitude sufficient to show upon the scale of the map. It is necessary, therefore, in these determinations to use the best instruments and the most refined methods known to modern science, in order to reduce all avoidable errors to a minimum.

Whatever determinations have been made by the U. S. Coast and Geodetic Survey, the United States Lake Survey, or the Mississippi River Commission, whether by astronomical work or by triangulation, these positions may be utilized for the above purposes.

DEFINITIONS.

Sidereal time is the time indicated by the stars, a sidereal day being the time which elapses between two passages of the vernal equinox across the meridian. Solar or apparent time is the time measured by the sun's apparent movement or the revolution of the earth with reference to the sun, and since the earth revolves at a differing rate in different portions of its orbit, the solar days are not of equal length. A mean day is the average solar day; mean time differs from solar time by an amount which varies with the time of year, and which, under the name of "equation of time," is given in the Nautical Almanac. Mean time differs from sidereal time by about a day in the course of a year, or about four minutes in each day; the mean day being longer than the sidereal day. To convert a given date of mean time into sidereal time it is necessary to obtain, from the Nautical Almanac, the sidereal time at noon immediately preceding the date in question. Then the interval after noon, expressed in mean time, is converted into sidereal time by table XXXII in this volume, and the result added to the sidereal time of mean noon. Local time, whether sidereal, solar, or mean, is the time of the locality as distinguished from the time of any other locality. It must be distinguished from railroad time, which is the local time only of certain meridians.

The right ascension of the sun or a star is the sidereal time which has elapsed between the passage of the vernal equinox and the star across the meridian. It is commonly expressed in hours, minutes, and seconds.

Declination is the angular distance of a heavenly body north or south of the equator. It is plus when north and minus when south of the equator.

The zenith distance of a heavenly body equals its declination, minus the latitude of the place of observation.

Latitude is determined by what is known as Talcott's method, by measuring the differences of zenith distance at culmination of two stars which culminate on opposite sides of the zenith.

Longitude is determined by telegraphic comparison of local time at two stations, the longitude of one of which is known. This involves the determination of the errors of the clocks or chronometers used, which is done by observation of transits of stars across the meridians of the places of observation.

ASTRONOMICAL TRANSIT AND ZENITH TELESCOPE.

A single instrument is used for the determination both of latitude and time. This is a combination of the transit and zenith telescope. The instruments in use upon the Geological Survey were made by Saegmuller and embody the latest improvements in these combined instruments. One of them is figured herewith. The circular base rests upon three leveling screws. Upon this circular base the whole instrument can be made to revolve when using it as a zenith telescope A circle is graduated around the base, having a micrometer screw for slow motion, for making settings and adjusting the instrument in azimuth. The frame of the instrument is cast in one piece, and the standards are hollow in order to reduce the weight of the upper part of the instrument. The telescope has a focal distance of 27 inches and a clear aperture of 2.5 inches. Its magnifying power with diagonal eyepiece is 74 diameters. The length of the axis of

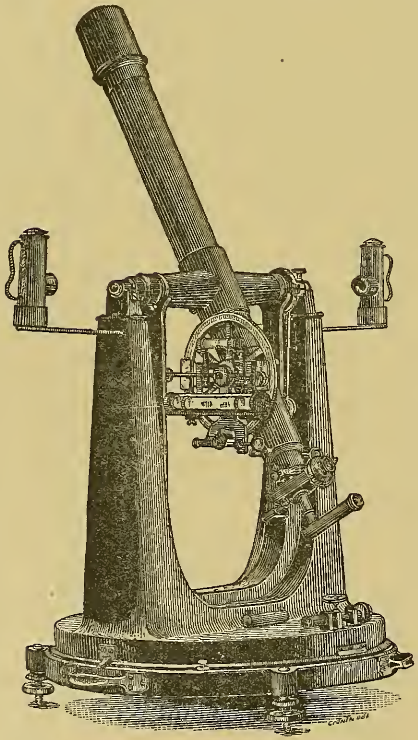


FIG. 1.—Astronomical transit and zenith telescope.

the telescope is 16 inches. For use as a zenith telescope, the telescope is equipped with a vertical circle reading by vernier to 20 seconds, attached to which is a delicate level. In the focus of the object-glass there is, besides the ordinary reticule for use in transit work, a movable thread, which is moved by means of a micrometer screw, by which measurements of differences of zenith distances are made. It is furnished with direct and diagonal eyepieces, the latter of which is commonly used in astronomical work.

For use as a transit instrument, the telescope is equipped with a delicate striding level for measuring the inclination of the pivots, and a reversing apparatus for turning the telescope in the wyes. The reticule, as the stationary threads in the focus of the instrument are called, consists of five threads for observing the transits of stars. The reticule is illuminated by means of bull's-eye lamps, the light from which comes through the hollow axis of the telescope and is reflected by a mirror placed at the intersection of the telescope with its axis.

CHRONOGRAPH.

The chronograph is used for the purpose of recording the time of transits of stars as observed with the transit instrument. It may be popularly characterized as an instrument for measuring time by the yard. It consists essentially of a drum, upon which is wound a strip of paper, and which is kept in revolution by a train of clockwork controlled by an escapement. A pen carried upon a small car, which is moved very slowly in a direction parallel to the axis of the cylinder, traces a spiral line upon the paper on the drum. This pen is held in place by a magnet, which is carried upon the car, and as long as the current from the battery passes through the coil and thus holds the armature the pen traces an unbroken spiral line. If the current is suddenly broken and restored, the armature is set free for an instant and a jog is made in the line traced. The battery commonly used in connection with this outfit is the ordinary zinc, copper, and sulphate of copper battery, of which four cells are usually required. The ordinary dry battery can also be used and is much more convenient. With this apparatus break-circuit chronometers are used. These differ from ordinary chronometers in the fact that they are arranged to break an electric circuit automatically at regular intervals. Those in use upon the Geological Survey break the circuit every two seconds, and the end of the minute is indicated by breaking at the fifty-ninth as well as the fifty-eighth and sixtieth seconds. When one of these chronometers is connected with a battery and a chronograph is put in the same circuit, the beginning of every even second is recorded upon the chronograph by a jog on the paper, and the distance between the jogs in each case represents, therefore, two seconds. The observer at the instrument is provided with a telegraph key, which may also be put in the circuit with the chronometer and chronograph, and as a star near the meridian crosses a thread in the telescope he records that fact by pressing on the key, which makes a record upon the chronograph along with the record of the chronometer.

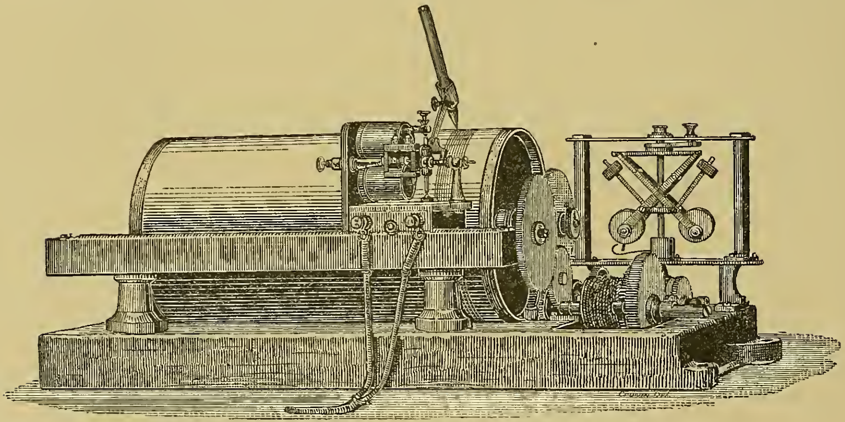


FIG. 2.—Chronograph.

An illustration of the form of chronograph in use upon the Geological Survey is shown upon Fig. 2.

FIELD WORK.

Since the observations for latitude and longitude, though different, are made with the same instrument, at the same time, and by the same party, certain parts of the work apply equally to both determinations and may be described once for all.

In the selection of a station, care must be taken to avoid a locality where, for any cause, the ground is liable to be seriously jarred, as, for instance, proximity to a railroad track or to a street over which heavy wagons pass. It should have a clear view from the southern horizon through the zenith to the northern horizon. It is desirable to locate at a convenient distance from a telegraph station, as it is necessary to bring a wire in from such station for the purpose of comparing chronometers. If possible, the station should be selected upon a public reservation, in order that the permanence of the monument marking the spot, which is to be erected, may be assured. But, in any event, one should avoid a locality in which such a monument is likely to be disturbed.

The support of the instrument should consist of a brick pier sunken fully three feet in the ground and rising above it to the requisite height. Upon this should be placed for the immediate support of the instrument, a block of stone well set in mortar. The chronograph may be set up on an ordinary table. Over all should be erected a wall tent with a slit closed by flaps in the roof, which can be opened when observing. The instrument is set up upon the pier, collimated, leveled, and the verticality of the threads tested as accurately as possible, and is then pointed upon the pole star. This places it somewhere near the meridian. Then taking the time of transit of a star which culminates close to the zenith, and comparing this time with the right ascension of the star, a sufficiently close approximation to the clock error is obtained for use in placing the instrument in the meridian. The instrument is then turned in azimuth to point upon some close circum-polar star approaching upper or lower culmination, moving the instrument in azimuth with the tangent screw so as to keep the star under the middle wire up to the instant of culmination. If this is done accurately at the first attempt, the instrument is placed nearly in the meridian and is ready for work, but it commonly happens that more than one trial is required before the meridian is reached. In any case, the result should be verified by a second star, before proceeding with the observations.

OBSERVATIONS FOR LATITUDE.

As preliminary to this work it is necessary to prepare a list of pairs of stars, the two stars of each pair having such zenith distances that they will culminate at nearly equal distances from the zenith, one to the north and the other to the south of it. Such a list can be prepared from the Safford Catalogue of the Wheeler Survey. For this it is necessary to know the approximate latitude of the station, the right ascensions and the declinations of the stars. The zenith distance of a star is equal to its declination, minus the latitude of the place. The stars of each pair should culminate within a few minutes of one another. They must be observed consecutively, and, therefore, those stars should be selected which culminate as nearly as possible together, leaving only a sufficient interval of time between them for setting the instrument.

Before beginning to observe, the instrument should be closely collimated and drawn into the meridian.

Upon the approach of the first star of the pair to the meridian, the instrument should be set for it, using the vertical circle for that purpose, and setting the spirit level upon the vertical circle as nearly level as possible. Then, as the star traverses the field of the telescope, keep the movable thread in the reticule upon it by means of the micrometer screw until it crosses the middle vertical thread. Then read and record the micrometer and the two ends of the level bubble. Without disturbing in the slightest degree the setting of the telescope, turn the entire instrument 180° upon its bed plate, when it will point north of the zenith, at the same angle that it formerly pointed south, or vice versa, as the case may be, and will be set for the other star upon the opposite side of the zenith. As this approaches culmination, follow it with the micrometer as before, until it reaches the middle thread; then record as before the readings of the micrometer and of the level, whether it has changed or not.

This constitutes the observations upon a single pair of stars. For the determination of latitude twenty such pairs of stars should be observed each evening, if possible, and the same pairs of stars should, also assuming it to be possible, be observed upon other evenings. The following example, taken from observations at Rapid, South Dakota, shows a portion of the star list and the form of record:

LATITUDE DETERMINATION.

List of Stars, for Observation with Zenith Telescope.

[Station: Rapid, South Dakota. Approximate Latitude: 44° 05′.]

Name or number. Safford's Catalogue.	Mag.	Class.	R. A.	Dec.	Zen. dist.	Setting.
			h. m.			° ′
7 Lacertæ	4.0	A A	22 27	49° 43′	5° 38′ N.	5 37 N.
10 Lacertæ	5.0	A A	22 34	38 29	5 36 S.	
1539	6.5	B	22 41	45 37	1 32 N.	1 27 N.
1551	6.5	A	22 47	42 42	1 23 S.	
1565	6.5	C	22 52	38 42	5 23 S.	5 22 S.
1579	5.0	A	22 59	49 26	5 21 N.	
1600	6.0	A	23 08	56 34	12 29 N.	12 19 N.
1633	6.7	B	23 18	31 56	12 09 S.	
1676	5.6	A	23 42	67 12	23 07 N.	23 05 N.
1686	6.5	A	23 47	21 03	23 02 S	
1702	4.5	A	23 52	24 32	19 33 S.	19 31 S.
1722	6.5	B	24 00	63 35	19 30 N.	

Example of Record.

[Station: Rapid, South Dakota. Date: November 9, 1890. Instrument: Fauth combined transit and zenith telescop
No. 534. Observer: S. S. G. Recorder: A. F. D.]

Star name or number.	N. or S.	Micrometer reading.	Diff.	Level.		(N+S) −(N′+S′)	Remarks.
				N.	S.		
		Rev.	*Rev.*	*Div.*	*Div.*	*Div.*	
7 Lacertæ	N.	26.256		39.9	16.7	+56.6	
10 Lacertæ	S.	24.052	−2.204	26.5	49.7	−76.2	
						−19.6	
1539	N.	30.432		42.0	18.7	+60.7	
1551	S.	20.095	−10.337	21.9	45.0	−66.9	
						− 6.2	
1565	S.	25.164		14.1	37.6	−51.7	Faint.
1579	N.	26.703	+1.539	38.1	15.0	+53.1	Distinct.
						+ 1.4	
1600	N.	32.214		37.5	14.1	+51.6	
1633	S.	16.033	−16.181	19.9	43.1	−63.0	Faint.
						−11.4	
1676	N.	26.656		51.0	28.0	+79.0	
1686	S.	17.684	−8.972	17.0	39.6	−56.6	
						−22.4	
1702	S.	25.345		18.0	40.9	−58.9	
1722	N.	23.722	+1.623	36.0	13.2	+49.2	
						− 9.7	

REDUCTION OF LATITUDE OBSERVATIONS.

Before proceeding with the reduction of latitude observations, it is necessary to investigate the constants of the instrument, to ascertain the value of a division of the latitude level, and of a division of the head of the micrometer screw.

The value of a division of the head of the micrometer screw is measured by observing the transits of some close circumpolar star, when near elongation, across the movable thread, setting the thread repeatedly at regular intervals in advance of the star, and taking the time of its passage, with the reading of the micrometer. The precaution should be taken to read the latitude level occasionally and correct for it if necessary. This correction, which is to be applied to the observed time, is equal to one division of the level, in seconds of time, divided by the cosine of the declination of the star and multiplied by the level error, the average level reading being taken as the standard.

The time from elongation of the star requires a correction in order to reduce the curve in which the star apparently travels to a vertical line. The hour angle of the star is first obtained from the equation,

$$\cos t_0 = \cot \delta \tan \varphi,$$

δ being the star's declination and φ the latitude.

The chronometer time of elongation, $T_0 = \alpha - t_0 - \delta t$, α being the right ascension of the star obtained from the Nautical Almanac, and δt the error of the chronometer.

Having thus obtained the chronometric time of elongation, the correction in question is obtained from the observed interval of time of each observation before or after elongation, from tables in Appendix No. 14, U. S. Coast and Geodetic Survey Report for 1880, pp. 58 and 59. A discussion of this subject will be found in the appendix above referred to, and in Chauvenet's Practical Astronomy, vol. II, pp. 360 to 364.

The times of observation thus corrected for level, and distance from elongation, are then grouped in pairs, selected as being a certain number of revolutions of the micrometer apart, and the time intervals between the members of each pair obtained. The mean of these, divided by the sum of revolutions which separate the members of each pair, is yet to be corrected for differential refraction, which is derived from the following equation:

$$\text{Ref.} = 57''.7 \sin R \sec^2 Z.$$

R being the value of a division of the micrometer and Z the zenith distance of the star. Four-place logarithms are sufficient for computing this correction, as it is small. Below is given an example of record and computation of the value of a revolution of the micrometer of combined instrument No. 534, one of the two in possession of the Geological Survey.

Determination of value of one revolution of micrometer belonging to Z. T. No. 534, by observations on 51 Cephei near eastern elongation, November 15, 1890, Rapid City, South Dakota.

log. cot. δ...87° 12′ 50″.8 = 8.6871826
log. tan Φ...44 04 45 = 9.9860380
log. cos. t_0..87 17 57 = 8.6732206

log. 1 div............ = 1.33 = 0.12385
A. C. log. cos. δ .... = 1.31334
A. C. log. 15................ = 8.82391
log. 1.82 s.................... = 0.26110

t_0 = 5 h 49 m 11.8 s
a = 6 49 20.4
T_0 = 1 00 08.6
Δt = −8.0
chron. time elong. = 1 00 00.6

Time of observation (recorded on chronograph sheet).	Micrometer revolutions.	Level. N.	Level. S.	Level. N + S.	Reduction to mean level.	Correction for change of level.	Time from elongation. = t.	Correction for t.	Reduced time.	Revolutions.	Time for nine revolutions.
h. m. s.		*Div.*	*Div.*	*Div.*	*Div.* *s.*	*s.*	*m. s.*	*s.*	*h. m. s.*		*m. s.*
00 40 19.7	31.0	37.0	16.0	53.0	+0.8× 1.82=	+1.5	−19 40.9	+1.4	00 40 22.6	31.0 and 22.0	15 37.7
41 12.3	30.5					+1.3	18 48.3	+1.3	41 14.9	30.5 21.5	36.6
(lost on chronograph sheet.)	30.0	37.1	16.1	53.2	+0.6	+1.1				29.5 20.5	34.4
42 53.7	29.5					+0.8	17 06.9	+0.9	42 55.4	29.0 20.0	39.2
43 44.6	29.0					+0.5	16 16.0	+0.8	43 45.9	28.5 19.5	40.2
44 35.9	28.5					+0.3	15 24.7	+0.7	44 36.9	28.0 19.0	36.9
45 31.9	28.0					+0.0	14 28.7	+0.5	45 32.4	26.5 17.5	36.8
(missed)	27.5					−0.3				26.0 17.0	37.5
(missed)	27.0					−0.5				25.5 16.5	36.2
48 08.0	26.5					−0.8	11 52.6	+0.3	48 07.5	25.0 16.0	29.6
48 57.1	26.0	38.3	17.5	55.8	−0.6	−1.1	11 03.5	+0.2	48 56.2	24.5 15.5	33.1
49 50.2	25.5					−1.1	10 10.4	+0.2	49 49.3	23.5 14.5	36.5
50 47.0	25.0					−1.0	9 13.6	+0.1	50 46.1	23.0 14.0	31.3
51 42.3	24.5					−1.0	8 18.3	+0.1	51 41.4	22.5 13.5	35.2
(missed)	24.0					−0.9					15 35.80=mean
53 22.4	23.5	38.3	17.3	55.6	−0.5	−0.9	6 38.2	+0.1	53 21.6		
54 18.8	23.0					−0.9	5 41.8	+0.0	54 17.9		
55 07.1	22.5					−0.9	4 53.5	0.0	55 06.2		
56 01.2	22.0					−0.9	3 59.4	0.0	56 00.3		
56 52.4	21.5	38.3	17.3	55.6	−0.5	−0.9	3 08.5	0.0	56 51.5		
57 41.2	21.0					−0.9	2 19.4	0.0	57 40.3		
58 30.7	20.5					−0.9	1 29.9	0.0	58 29.8		
59 25.9	20.0					−0.8	− 0 34.7	+0.0	59 25.1		
1 00 17.9	19.5					−0.8	+ 0 17.3	−0.0	1 00 17.1		
01 10.0	19.0					−0.7	1 09.4	0.0	01 09.3		
(missed)	18.5					−0.6		0.0			
02 52.8	18.0					−0.6	2 52.2	0.0	02 52.2		
03 44.8	17.5	38.0	17.0	55.0	−0.3	−0.5	3 44.2	0.0	03 44.3		
04 34.2	17.0					−0.5	4 33.6	0.0	04 33.7		
05 25.9	16.5					−0.4	5 25.3	0.0	05 25.5		
06 16.0	16.0					−0.3	6 15.4	0.0	06 15.7		
07 14.8	15.5					−0.2	7 14.2	−0.1	07 14.5		
08 05.1	15.0					−0.1	8 04.5	−0.1	08 04.9		
08 58.2	14.5	37.8	16.8	54.6	−0.0	−0.0	8 57.6	−0.1	08 58.1		
09 49.1	14.0					+0.3	9 48.5	−0.2	09 49.2		
10 41.0	13.5					+0.6	10 40.4	−0.2	10 41.4		
11 35.0	13.0	37.2	16.2	53.4	+0.5	+0.9	11 34.4	−0.3	11 35.6		
Mean level..				=54.5							

log...................935.80 s. = 2.97118
log. cos. δ............ 8.68666
log. 15................ 1.17659
A. C. log 9.......... 9.04576
log R ....75″.804 = 1.87969
Refraction ...— .044
One rev'lut'n=75.760

DIFF. REFRACTION.

log....................57″.7 = 1.7612
log. sin................75 .8 = 6.5652
log. sec. z 0.1568
log. sec. z 0.1568
Diff. refr ......=″.044 log. = 8.0400

The value of a division of the level is commonly measured with a level trier. The latitude level may, however, be easily measured by means of the micrometer, the value of a revolution of that being obtained by the following method:

Point the telescope upon some well-defined terrestrial mark and set the level at an extreme reading near one end of the tube. Set the movable thread upon the object and read the micrometer and the level.

Now move the telescope and level, until the bubble is near the other end of the tube. Again set the movable thread upon the object and again read both micrometer and level. It is evident that the micrometer and the level have measured the same angle, and that the ratio between these readings equals that between a revolution of the micrometer and a level division.

An example illustrative of this is appended.

Determination of value of 1 division of latitude level No. 534.

[By comparison with micrometer screw 534]

Micrometer.	Level.		Difference.		aa.	ab.
	N.	S.	Microm.	Level.		
r.	*d.*	*d.*	*b.* *d.*	*a.* *d.*		
8.025	47.3	29.2				
8.508	20.7	02.7	48.3	26.55	704.9	1283.
8.509	18.9	01.0				
7.984	49.8	31.0	52.5	30.45	927.2	1599.
8.511	18.5	00.6				
8.045	47.2	29.1	46.6	28.60	818.0	1333.
9.076	18.7	00.8				
8.604	46.0	28.0	47.2	27.25	742.6	1286.
9.442	23.7	06.0				
9.009	48.0	30.0	43.3	24.15	583.2	1046.
10.055	21.8	04.0				
9.574	48.0	30.1	48.1	26.15	683.8	1258.
10.661	24.0	06.1				
10.212	50.7	33.0	44.9	26.80	718.2	1203.
11.771	18.3	00.7				
11.252	48.3	31.9	51.9	30.60	936.4	1588.
12.328	20.0	02.3				
11.872	46.1	28.5	45.6	26.15	683.8	1192.
12.869	22.2	04.6				
12.438	47.7	30.0	43.1	25.45	647.7	1097.
13.468	23.0	05.3				
13.080	44.5	26.9	38.8	21.55	464.4	836.
14.146	20.1	02.4				
13.702	45.4	27.8	44.4	25.35	642.6	1125.
14.758	22.3	04.8				
14.282	48.6	31.0	47.6	26.25	689.1	1249.
Sum.	....	....	....	....	9241.9	16095.

log....................16095. = 4.20669.

A. C. log ....9241.9 = 6.03424.

log 1 Div. Micrometer........ = 9.87966.

1 Div. level..... = 1″.320 log. = 0.12059.

Following the determination of the constants of the instrument used, the next step is to obtain the apparent declinations of the stars used. Whenever possible, these should be taken from the Nautical Almanac or the Berliner Jahrbuch. In other cases they must be computed. The positions of stars are given in Safford's Catalogue, for the epoch 1875.0, together with the annual precession and proper motion. The declinations there given should be revised by the aid of more recent catalogues, particularly with reference to stars of class C. The annual precession and proper motion multiplied by the number of years which have elapsed and applied, together with the effect of secular variation in precession, give the declination at the beginning of the year. Further corrections to bring the positions down to the date of observation are expressed by the symbols A*a*′, B*b*′, C*c*′, D*d*′. Logarithms of *a*′, *b*′, *c*′, *d*′ are given in Safford's Catalogue, and A, B, C, and D are given in the Nautical Almanac. A slight additional correction, also, is to be made for proper motion, for the elapsed portion of the year. This reduction is illustrated below.

LATITUDE DETERMINATION.

Example of reduction. Computation of apparent declination of star 1539.

[From Safford's Catalogue, p. 40.]

	Declination 1875.0	Annual precession.	Proper motion.
	° ′ ″	″	″
Star No. 1539	45 33 29.20	+ 18.87	—.03

Yr. (1890–1875) ×18″.87 = + 4′ 43″.05 = Precession for 15 years.
15×—″.03 = — 0 00.45 = Proper motion for 15 years.
+ 0 00.07 = Secular variation in precession.
= 45° 38′ 11″.87 = Declination 1890.
+ 9.38 = A a′
— 0.78 = B b′
+ 6.88 = C c′
+10.16 = D d′
— 0.03 = Proper motion, Jan. 1—Nov. 9, 1890.
45 38 37.48 = Declination Nov. 9, 1890.

	log a′ = 1.2757	log b′ = 9.5294	log c′ = 9.7367	log d′ = 9.8273
Nov. 9.	log A = 9.6966	log B = 0.3649_n	log C = 1.1006	log D = 1.1796
	0.9723	9.8943_n	0.8373	1.0069
	Aa′ = + 9″.38	Bb = — 0″.78	Cc′ = + 6″.88	Dd′ = + 10″.16

With all this preliminary work done, the reduction proper of latitude observations is comparatively a simple matter. Grouping the observations by pairs, the mean declination of each pair is obtained, the corrections for difference of micrometer readings and levels are applied, with a small correction for differential refraction, and the result is the desired latitude.

Following is an example of the reduction of six pairs of stars observed for latitude at Rapid, South Dakota:

LATITUDE DETERMINATION.

Example of Reduction.

[Station: Rapid, South Dakota. November 9, 1890. Half Rev. Micrometer=37″.900. One Div. Level=1″.33.]

Date.	Star numbers.	δ_1	δ_2	$\frac{1}{2}(\delta_1+\delta_2)$	Corrections.			Latitude n.	Weight p.	p. n.
					Microm.	Level.	Refr.			
		° ′ ″	° ′ ″	° ′ ″	′ ″	″	″	° ′ ″		″
Nov. 9.	7 Lacert and 10 Lacert.	49 42 87.33	38 29 04.60	44 06 15.97	− 1 23.53	−6.51	−.03	44 04 45.90	.98	5.78
	1539 1551	45 38 37.48	42 44 04.63	11 21.06	− 6 31.77	−2.06	−.11	47.12	.90	6.41
	1565 1579	38 43 39.78	49 27 41.04	05 40.41	− 0 58.33	+0.46	−.03	42.51	.79	1.98
	1600 1633	56 34 06.66	31 55 56.91	15 01.78	−10 13.25	−3.78	−.19	44.56	.90	4.10
	1676 1686	67 12 10.93	21 03 54.02	08 02.48	− 3 08.43	−7.44	−.07	46.54	.93	6.08
	1702 1722	24 32 09.04	63 35 27.34	03 48.19	+ 1 01.51	−3.22	+.02	46.50	.90	5.85
									5.40	30.20

November 9. Weighted mean=44° 04′ 45.59″.

OBSERVATIONS FOR TIME.

With the transit mounted, leveled, and adjusted in the meridian, the chronograph set up and running and connected in a circuit with the battery, and the chronometer and observing key connected in the same circuit the observer is prepared to begin time observations.

The list of stars which should be used is that given in the Berliner Jahrbuch as the list is fuller and more accurate than that in any other catalogue which gives day places. Stars should be so selected north and south of the zenith that the azimuth errors will balance one another as nearly as possible, as is explained hereafter. On the approach of the selected star to the meridian, the telescope is set by means of the vertical circle upon the altitude of the star above the horizon, deduced from the declination and the latitude. As the star crosses each thread in the reticule, the fact is recorded by pressing the observing key, which produces, as described above, a record upon the chronograph sheet. In this way four time stars, as stars between the equator and zenith are designated, and one circumpolar star, or a star so near the pole that it is constantly in sight, should be observed. Then the telescope should be reversed in the wyes and a similar set of stars observed.

Between observations upon any two stars the striding level should be placed upon the pivots of the instrument and readings taken to ascertain the departure of the axis from a horizontal position.

In order to avoid unequal expansion of the pivots from unequal heating, both bull's-eye lamps must be lighted and placed in their stands, in order that both pivots may be equally heated.

After the comparison of chronometers at the two stations, to be hereafter described, a similar set of stars should be observed, if possible.

REDUCTION OF TIME OBSERVATIONS.

Certain constants of the transits should be measured before proceeding with the reduction of time observations. The value of a division of the striding level should be measured by means of a level trier. The equatorial interval of time between each of the threads and the mean of all the threads should be obtained, as it is not infrequently needed in utilizing broken or imperfect observations. These can best be obtained from observations on slow moving stars, but any stars may be used for the purpose. The intervals as observed, are reduced to the equator by multiplying them by the cosine of the declination of the star observed.

The object of these observations is specifically the determination of the error of the chronometer. This error equals the right ascension of a star minus its observed time of transit, corrected for certain instrumental errors. These errors are as follows:

CORRECTION FOR ERROR OF LEVEL.

The level error, designated by b, is ascertained from the readings of the striding level. The value of a division of the level in seconds of time must have been previously ascertained by means of a level trier. The effect of the level error is greatest at the zenith and diminishes to zero at the horizon. The correction in seconds of time is given by the following equation:

$$\text{Cor} = b \cos(\varphi - \delta) \sec \delta = b\text{B}.$$

When the declination is north, it is to be regarded as having a plus sign for upper and a minus sign for lower culmination. When south it is negative.

CORRECTION FOR INEQUALITY OF PIVOTS.

This correction can be made a part of the level correction.

Let p = the inequality of pivots.
B = inclination of axis given by level for clamp west.
B' = inclination of axis given by level for clamp east.
b = true inclination of axis for clamp west.
b' = true inclination of axis for clamp east.

then $p = \frac{B' - B}{4}$

$b = B + p$ for clamp west.
$b' = B' - p$ for clamp east.

(Chauvenet, vol. II, p. 155.)

CORRECTION FOR ERROR OF COLLIMATION.

This correction, designated by c, is the departure of the mean of the threads from the optical axis of the telescope. For stars at upper culmination with clamp west it is plus when the mean of the threads is east of the axis, and minus when it is west of it. For stars at lower culmination the reverse is the case. The value of c is one-half the difference between the clock error indicated by stars observed before and after reversal of the instrument, divided by the mean secant of the declinations of the stars. This is slightly complicated with the azimuth, although the effect of that is largely eliminated by the proper selection of stars. Consequently it is to be obtained by approximations, in conjunction with the azimuth errors. The correction to be applied to each star equals $c \sec \delta = c\mathrm{C}$, which is plus for a star at upper culmination and minus for a star at lower culmination. It is least for equatorial stars and increases with the secant of the declination.

CORRECTION FOR DEVIATION IN AZIMUTH.

This correction, designated by a, represents the error in the setting of the instrument in the meridian. Its effect is zero at the zenith and increases toward the horizon. Since the instrument is liable to be disturbed during the operation of reversal, it is necessary to determine the azimuth error, both before and after reversal, separately. A comparison of the clock error, determined from observations upon north and south stars, will furnish the data necessary for the determination of azimuth. Practically, it is determined by elimination from equations involving the mean of all these stars observed in each of the two positions of the instrument, after correcting for level, and as it is slightly complicated with collimation it must be reached by two or more approximations. The error is essentially positive when the telescope points east of south, and negative when west of south. The correction applicable to any star is expressed in the following equation:

$$\text{Cor.} = a \sin(\varphi - \delta) \sec \delta = a\text{A}.$$

It must be understood that the declination when north is positive for upper and negative for lower culmination, and that with south declination it is negative.

CORRECTION FOR DIURNAL ABERRATION.

The right ascension of stars, as taken from the Berliner Jahrbuch, must be corrected for diurnal aberration, which equals $0^{s}.021 \cos \varphi \sec \delta$. This correction is positive for upper and negative for lower culmination.

These corrections are summarized in the following equation:

$$\Delta t = \alpha - (t + a\text{A} + b\text{B} + c\text{C}).$$

A, B, C, as seen above, are constants, depending upon the latitude of the place of observation and the declination of the star. Tables for these quantities will be found in an appendix to Annual Report U. S. Coast and Geodetic Survey for 1874.

The following is an example of the form for record of observation and reduction of time observations, taken from a campaign for the determination of position of Rapid, South Dakota.

Time determination: Example of record.

[Rapid, South Dakota, November 20, 1890. Fauth transit, No. 534. Sidereal chronometer: Bond & Sons, No. 187
1 division of level = $0^s.118$. Hourly rate of chronometer = $0^s.133$.]

Star	γ Cephei.	φ Pegasi.	ω Piscium.	33 Piscium.	α Androm.	
Clamp	W.	W.	W.	W.	W.	W.
Level	telescope north *W.* *Sum.* *E.* *d* *d* *d* 19.8 −88.1 68.3 68.2 +87.6 19.4	telescope south. *W.* *Sum.* *E.* *d* *d* *d* 68.0 +87.1 19 1 20.2 −89.2 69.0	telescope south. *W.* *Sum.* *E.* *d* *d* *d* 20.0 −89.5 69.5 68.8 +87.2 18.4	telescope south. *W.* *Sum.* *E.* *d* *d* *d* 68.2 +86.9 18.7 19.9 −89.4 69.5	telescope south. *W.* *Sum.* *E.* *d* *d* *d* 19.8 −89.3 69.5 68.3 +86.8 18.5	telescope north. *W.* *Sum.* *E.* *d* *d* *d* 19.7 −89.5 69.8 68.8 +87.3 18.5
Difference =	− 0.5	− 2.1	− 2.3	− 2.5	− 2.5	− 2.2
	h. *m.* *s.*	*h.* *m.* *s.*	*h.* *m.* *s.*	*h.* *m.* *s.*	*h.* *m.* *s.*	
Thread I	23 34 52.25	23 47 24.00	23 54 10.89	00 00 13.33	00 03 12.00	
II	35 11.40	28.55	14.88	17.96	16.83	
III	29.41	32.72	19.22	21.94	21.32	
IV	46.78	36.75	23.14	25.95	26.00	
V	36 05.00	41.09	27.20	29.83	30.85	
Sum	= 4.84	3.11	5.33	9.01	7.00	
Mean	23 35 28.97	23 47 32.62	23 54 19.07	00 00 21.80	00 03 21.40	
Aberration	−.07	−.02	−.02	−.02	−.02	
Correction for level	*b* B −.22	−.06	−.05	−.04	−.06	
Correction for rate	+.05	+.03	+.01	+.00	+.00	
Reduced transit	23 35 28.83	23 47 32.57	23 54 19.01	00 00 21.74	00 03 21.32	
Tabular R. A.	23 34 53.13	46 55.67	53 41.98	23 59 44.61	00 02 44.42	
a − *t* =	−35.70	−36.90	−37.03	−37.13	−36.90	

Mean of levels $= -\frac{\overset{div.}{2.02}}{4} \times \overset{s.}{.118} = -\overset{s.}{.0596} = b$. Inequality of pivots.. $= \overset{s.}{.00}$

Star	γ Pegasi.	Br. 6.	ι Ceti.	44 Piscium.	12 Ceti.
Clamp	E.	E.	E.	E.	E.
Level	Telescope south. *W.* *Sum.* *E.* 19.2 −88.3 69.1 68.9 +87.8 18.9 *d* ..... − 0.5	Telescope south. *W.* *Sum.* *E.* 68.7 +87.3 18.6 19.4 −88.7 69.3 *d* ..... − 1.4	Telescope south. *W.* *Sum.* *E.* 19.2 −88.4 69,2 68.5 +86.7 18.2 *d* ..... − 1.7	Telescope north. *W.* *Sum.* *E.* 68.9 +87.8 18.9 18.9 −87.9 69.0 *d* ..... − 0.1	
	h. *m.* *s.*	*h.* *m.* *s.*	*h.* *m.* *s.*	*h.* *m.* *s.*	*h.* *m.* *s.*
Thread V	00 08 05.25	00 10 05.00	00 14 20.70	00 20 17.35	00 24 56.85
IV	09.30	22.81	24.68	20.84	25 00.73
III	13.54	39.30	28.52	24.93	05.37
II	17.65	56.90	32.90	29.16	09.15
I	22.00	11 15.49	37.23	33.42	13.07
	Sum.= 7.74	.. 9.50	4.03	5.70	5.17
Mean	00 08 13.55	39.90	28.81	25.14	05.03
Correction for aberration	−.02	−.06	−.02	−.02	−.02
Correction for level ......*b* B=	−.02	−.09	−.02	−.02	−.02
Correction for rate	−.02	−.02	−.03	−.04	−.05
Reduced transit ......*t*=	00 08 13.49	00 10 39.73	00 14 28.74	00 20 25.06	00 25 04.94
Tabular *R. A.* ......*a*=	00 07 36.59	10 03.56	00 13 51.75	00 19 48.17	00 24 27.91
a—*t*=	−36.90	−36.17	−36.99	−36.89	−37.03

Mean of levels $= -\frac{\overset{Div.}{.925}}{4} \times \overset{s.}{.118} = -\overset{s.}{.027} = b$. Inequality of pivots $= \overset{s.}{.00}$.

LONGITUDE DETERMINATION.

Example of reduction.

[Rapid, South Dakota, November 20, 1890. After exchange of clock signals.]

Clamp.	1.	2. Star.	3. A.	4. C.	5. a—t	6. Cc.	7. a—t Corrected for Cc.	8. Aa_w.	9. Corrected for Δa_w.	10. Cc'.	11.	12. Aa'_w.	13.	V.	t.
	Wt. Δt_0				s.	s. c=—.019 s.	s.	s.	s.	s. C' +.015 s	s.		s.	s.	h.
W.	1	γ Cephei	—2.42	+4.45	— 35.70	—.08	—35.78	—1.00	—36.78	+.07	—36.71	—.05	—36.76	.00	23.58
	1	φ Pegasi	+0.45	1.05	36.90	—.02	36.92	+0.19	.73	.01	.73	+.01	.71	—.05	.78
	1	ω Piscium	+0.62	1.01	37.03	—.02	37.05	+0.26	.79	.02	.77	+.01	.76	.00	.89
	1	33 Piscium	+0.77	1.01	37.13	—.02	37.15	+0.32	.83	.01	.82	+.02	.80	+.04	.99
	1	α Androm	+0.30	+1.14	— 36.90	—.02	—36.92	+0.12	—36.80	+.02	.78	+.01	.77	+.01	24.01
		Sum =	+2.14										3.80		
		Sum =	—2.42	+8.66	—183.66				3.93						
		(1) Mean =	—0.06Aw	+1.73c	— 36.732				—36.786				—36.760		
								Aa.				Aa'_w.			
E.	1	γ Pegasi	+0.51	—1.03	— 36.90	+.02	—36.88	+0.15	—36.73	—.01	—36.74	—.01	—36.75	.01	24.13
	1	Bradley 6	—2.26	4.23	36.17	.08	36.09	— .64	.73	.06	.79	+.03	.76	.00	.17
	1	ι Ceti	+0.81	1.01	36.99	.02	36.97	+ .23	.74	.02	.76	—.01	.77	+.01	.23
	1	44 Piscium	+0.68	1.00	36.89	.02	36.87	+ .19	.68	.01	.69	—.01	.70	—.06	.33
	1	12 Ceti	+0.75	—1.00	— 37.03	+.02	—37.01	+ .21	—36.80	—.02	.82	—.01	.83	+.07	.41
		Sum =	+2.75										3.81		
		Sum =	—2.26	—8.27	—183.98				3.68					Mean	—24.05
		(2) Mean =	+0.10Ae	—1.65c	— 36.796				—36.736				—36.762		

Subtracting (2) from (1), ignoring azimuth terms which are small, we have:

$$+3.38c + \overset{s.}{.064} = 0$$

Approx ......c = $\overset{s.}{—.019}$

From below . c' = +.015 Adopted . . c = $\overset{s.}{—.004}$

$$\begin{array}{ll} -2.42\ Aw\ \overset{s.}{-35.78} = 0 & -2.26\ Ae\ \overset{s.}{-36.09} = 0 \\ +0.54 \quad\ -37.01 = 0 & +0.69 \quad\ -36.93 = 0 \\ \hline +2.96\ Aw - \overset{s.}{1.23} = 0 & +2.95\ Ae - \overset{s.}{0.84} = 0 \\ Aw = \overset{s.}{+.415} & Ae = \overset{s.}{+.285} \end{array}$$

Forming equations to determine c' from columns 4 and 9:

$$\begin{array}{l} +1.73c' \overset{s.}{-36.786} = 0 \\ -1.65 \quad -36.736 = 0 \\ +3.38c' - \overset{s.}{0.050} = 0 \\ c' = \overset{s.}{+.015} \end{array}$$

Forming equations from columns 3 and 11:

$$\begin{array}{ll} -2.42\ A'w\ \overset{s.}{-36.710} = 0 & -2.26\ A'e\ \overset{s.}{-36.790} = 0 \\ +0.54\ A'w\ -36.772 = 0 & +0.69 \quad\ -36.752 = 0 \\ \hline +2.96\ A'w - \overset{s.}{0.062} = 0 & +2.95\ A'e + \overset{s.}{0.038} = 0 \\ A'w = \overset{s.}{+.021} & A'e = \overset{s.}{-.013} \\ Aw = +.415 & Ae = +.285 \end{array}$$

Adopted . Aw = $\overset{s.}{+.436}$ Adopted . Ae = $\overset{s.}{+.272}$
Adopted . . . C = —.004

Normal equation, formed from columns 1, 3, 4, and 5

$$10\Delta t - .28Aw + .49Ae + .39c + \overset{s.}{367.64} = 0$$

$$\Delta t - .028Aw + .049Ae + .039c + \overset{s.}{36.764} = 0$$

$$\Delta t = \overset{s.}{-36.76} \quad \text{at } \overset{h.}{24.05}$$

$$\begin{array}{rr} a - t = & \overset{s.}{-36.764} \\ -.028 \times \overset{s.}{+.436} = & -.012 \\ +.049 \times \overset{s.}{+.272} = & +.013 \\ +.039 \times \overset{s.}{-.004} = & -.000 \\ \hline \Delta t = & -36.763 \end{array}$$

COMPARISON OF TIME.

After time has been thus observed the chronometers at the two stations should be compared by telegraph.

Chronometers are compared in the following manner: The chronometer at one station being in circuit with the chronograph and recording upon it, the chronometer at the other station is switched into the general telegraphic circuit, by which it is brought to the first station and switched into the local circuit there, so that the two chronometers register upon the same chronograph, their beats being marked side by side by the same pen. After this has gone on for a minute or more the operation is reversed, the chronometer at the first station is switched into the telegraphic circuit and made to record upon the chronograph with the chronometer at the second station. Of course the observers are informed of the hour and minute at which the joint record upon the several chronographs begins.

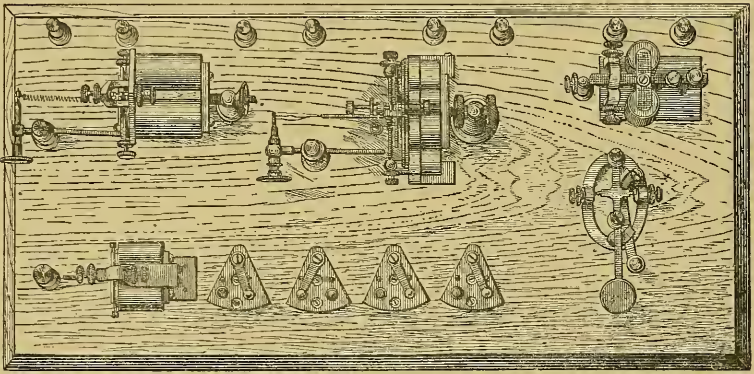


Fig. 3.—Switchboard.

This method constitutes what is known as the automatic exchange of signals.

The *arbitrary* exchange of signals is made as follows:

Each chronometer recording on its own chronograph as usual, and each local circuit being connected with the main-line circuit, the observer at one station breaks the circuit by means of the main-line talking-key, which break is recorded on the chronograph sheets at both stations. The breaks are repeated at every two seconds for at least one full minute. The operation is then reversed by the observer at the second station making the breaks which are recorded at both stations as before.

The differences of time between the chronometers at the two stations are read from the chronograph sheets at each station and corrected for error of the chronometers. The results from the two chronograph sheets will differ by an amount equal to twice the time occupied in transmission of signals. The mean of the two is therefore the approximate difference of longitude.

This result is yet to be corrected for personal equation, or the difference between the errors of observing of the two observers. Every observer has the habit of recording a transit a little too early or too late, the difference between two observers not infrequently being as great as a fourth of a second. To measure this difference, the observers usually meet, preferably at the known station, both before and after the campaign, and observe for time each with his own instrument, or with one similar in all respects to that used in the campaign. A comparison of the time determinations made by the two observers gives an approximation to the personal equation.

A better method, but one not always practicable, is for the observers, having completed half of the observations for time and longitude, to exchange stations for the remainder of the work. The mean of the results before and after exchange of stations will eliminate personal equation.

There is one error incident to this work which can not be eliminated. This is the unequal attraction of gravity, or local attraction, or, as it is sometimes called, station error. The neighborhood of a mountain mass will attract the plumb line and deflect the spirit level to such an extent as to cause serious errors in astronomical determinations of latitude and time. The same result is frequently produced by a difference in density of the underlying strata of rock, so that station errors of magnitude often appear where they are not expected. Indeed, the station error can not be predicted with any certainty, either as to amount or even direction.

The only practical method of even partially eliminating this error is to select a number of stations for astronomical location, under conditions as widely diverse as possible, connect them by triangulation, and by this means reduce all these astronomical determinations to one point, thus obtaining for this point a number of astronomical determinations each having a different station error. The mean of these gives for this point a position from which—in part, at least—station error has been eliminated, and this mean position can be transferred back by means of the triangulation to the several astronomical stations, thus giving each of them a position similarly comparatively free from station error.

OBSERVATIONS FOR AZIMUTH.

The initial direction from which the directions of other lines in primary triangulation and in primary traversing are computed is obtained by means of astronomic observations. Such observations should be taken not only upon the initial line, but at intervals throughout the work for its verification. Such intervals should not exceed in the primary triangulation 100 miles, and in primary traversing 10 to 20 miles.

Azimuth observations are made with the theodolite used in primary triangulation or traverse. The observations consist in the measurement of the horizontal angle between some close circumpolar star, usually Polaris, and a terrestrial mark, generally a bull's-eye lantern set at a distance of half a mile to a mile from the observing station. The time of observation on the star should be noted by a chronometer or a good watch. As the star is at a much higher angle of elevation than the lamp it is necessary not only to level the instrument carefully but to measure the error of level and to correct for it. It is therefore essential that the value of a division of the level bulb be known. These observations for azimuth may be made at any time of the night, but preferably they should be made at or near the time of elongation of the star, as it is then moving most slowly in azimuth, and any error in the time of observation has the least effect upon the resulting azimuth. If such observations be taken at elongation, no record of time need be made, and the reduction of the observations is simplified. When such observations are made at any other time than at elongation, the time must be noted, as it forms an element in the reduction. The error of the clock or watch used may be obtained by comparison with railroad time, and corrected for the difference in longitude between the station and the meridian of the railroad time. A form of observation and record is appended.

AZIMUTH OBSERVATIONS.

Example of record.

[Station: West base, near Little Rock, Ark. Fauth 8″, theod. No. 300. December 27, 1888. 1 div. micr. = 2″. 1 div. level = 3″.]

Object.	Time P. M.	Level.		Micrometer.		Mean.	Angle.
		West end.	East end.	A.	B.		
				Telescope direct.			
	h. m. s.	Div.	Div.	° ′ Div.	° ′ Div.	° ′ ″	
Polaris	11 00 18	13.9 50.5	47.1 10.2	346 00 14.8	165 58 25.1	345 59 39.9	
		64.4 +7.1	57.3				° ′ ″ 115 32 30.0
East base (mark)				101 32 18.1	281 31 21.8	101 32 09.9	
East base (mark)				101 32 19.8	281 31 19.7	101 32 09.5	115 34 16.1
Polaris	11 09 20	50.4 13.8	10.3 46.5	345 58 22.0	165 57 01.4	345 57 53.4	
		64.2 +7.4	56.8				
				Telescope reverse.			
Polaris	11 17 14	50.5 12.9	10.1 46 6	211 28 29.0	31 27 23.4	211 28 22.4	
		63.4 +6.7	56.7				115 35 53.8
East base (mark)				327 05 06.7	147 03 09.5	327 04 16.2	
East base (mark)				327 04 26.3	147 03 00.6	327 03 56.9	115 37 08.8
Polaris	11 26 22	14.3 50.1	46.3 10.5	211 27 10.7	31 26 07.4	211 26 48.1	
		64.4 +7.6	56.8				

AZIMUTH OBSERVATIONS.

Summary of results.

[Station: West base, Arkansas. December 27, 1888.]

Individual results.			Combined results.
	° ′ ″	″	° ′ ″
First set	294 10 34.2 36.3	35.25 D.	38.80
	49.9 34.8	42.35 R.	
	35.9 46.3	41.10 R.	39.38
	41.8 33.5	37.65 D.	
Second set	42.4 45.4	43.90 D.	38.75
	26.4 40.8	33.60 R.	
	49.1 45.0	47.05 R.	40.10
	40.3 26.0	33.15 D.	
Grand mean			294 10 39.26

REDUCTION OF AZIMUTH OBSERVATIONS.

The time of observation of a star is first to be corrected for the difference in longitude, assuming that railroad time has been used, and for the error of the watch. It is then reduced from mean to sidereal time. From the sidereal time of observation is to be subtracted the right ascension of Polaris, if that star is used, which is given in the Nautical Almanac, the result being the hour angle or the sidereal time which has elapsed since it passed the meridian of the place of observation, given in hours, minutes, and seconds. This result is to be converted into degrees, minutes, and seconds.

Then $\tan A = -\frac{a \sin t}{1 - b \cos t}$

where $a = \sec \varphi \cot \delta$, $\varphi =$ the latitude.

$b = \frac{\tan \varphi}{\tan \delta}$ $\delta =$ the declination of star.

$t =$ hour angle.

$A =$ angle between north pole and the mark.

This angle is to be corrected for level as follows:

$$\text{level corr.} = -\frac{d}{4}\left\{(w+w')-(e+e')\right\}\tan h.$$

d being the value of a division of the level.

$w+w'$, readings of west end of level bubble.

$e+e'$, readings of east end of level bubble.

h, the angular elevation of pole star.

An example of reduction is as follows:

AZIMUTH OBSERVATIONS.

Example of reduction.

[Station: West base; December 27, 1888. Observer, S. S. G. Latitude = 34° 45′ 26.8″ Longitude 92° 13′ 31.5″.]

		h.	m.	s.
Time of observation = Tw		= 11	00	18
Correction; ninetieth meridian time to 92°.215		= —	8	54
Watch slow; ninetieth meridian time		+		02
local mean time	Tm	= 10	51	26
Correction; mean to sidereal time		=	+1	47
Right ascension mean sun		18	26	36
Sidereal time of observation		= 29	19	49
R. A. Polaris		— 1	18	25
Hour angle	t	= 28	01	24
		— 24		
		h.	m.	s.
	t (time)	= 4	01	24
		°	′	″
	t (arc)	= 60	21	00

$$\tan A = -\frac{a \sin t}{1 - b \cos t} \quad \text{where } a = \sec \phi \cot \delta \quad b = \frac{\tan \phi}{\tan \delta}$$

	°	′	″			
$\phi =$	34	45	26.8	log sec = 0.0853539	log tan . . 34° 45′ 26.8″	= 9.8413076
$\delta =$	88	43	11.9	log cot. = 8.3491690	log tan . . 88 43 11.9	= 1.6508310
log a	°	′	″	= 8.4345229	log b	= 8.1904766
log sin t	60	21	00.	= 9.9390515	log cos t	= 9.6943423
log a sin t				= 8.3735744	log —. 0076704	= 7.8848189
log (1 — b cos t)	°	′	″	= 9.9966559	+ 1.0000000	
log tan A	178	38	08.0	= 8.3769185	0.9923296	= 1 — b cos t
angle to mark	+115	32	30.0			
Level corr.			—3.8			
	°	′	″			
Az. of mark =	294	10	34.2			

$$\text{level corr.} = -\frac{d}{4}\left\{(w + w') - (e - e')\right\} \tan h.$$

$$= \frac{3.1''}{4} \times 7.1 \text{ Div.} \times .694 = -3.8''$$

When observations for azimuth are to be made at elongation, it is necessary to know the mean time of elongation. This is computed by the following method: the hour angle at elongation is obtained from the following equation:

$$\cos t_e = \tan \varphi \cot \delta.$$

The hour angle plus the right ascension of the star gives the sidereal time of its western elongation, which, reduced to mean time, gives the local mean time in question.

The azimuth of a pole star at elongation is determined by the use of the following equation:

$$\sin A = \sec \varphi \cos \delta.$$

The following is an example of these computations:

Example of the computation of the azimuth at elongation, and the local mean times of both elongations of Polaris.

[Latitude = ϕ = 40°. Meridian of Washington. November 28, 1891.]

Sine Azimuth at elongation = sec. ϕ cos δ.

	°	′	″	
log. sec. 40°				= 0.1157460
log. cos δ	88	44	05.5	= 8.3439803
log. sine A	1	39	05.8	= 8.4597263

Cos. hour angle at elongation, t_e, = tan ϕ cot δ.

	°	′	″	
log. tan 40°				= 9.9238155
log. cot δ	88	44	05.5	= 8.3440862
log, cos t_e	88	56	17.5	= 8.2678997
	h.	*m.*	*s.*	
t_e =	5	55	45.2.	

Sidereal time western elongation, T_s = R. A. Polaris + t_e.

		h.	*m.*	*s.*	
R. A. Polaris	=	1	19	35.2	
t_e	=	5	55	45.2	
Sidereal time western elongation	T_s =	7	15	20.4	
R. A. mean sun =	a_s =	16	29	14.4	
Sideral interval before noon, I	=	9	13	54.0	
Correction sidereal to mean interval			1	30.7	
Mean interval before noon		9	12	23.3	Nov. 28.
Local mean time, western elongation	=	2	47	36.7	A. M., Nov. 28.

		h.	*m.*	*s.*	
Sidereal time eastern elongation = $24^h + a - te$	=	19	23	50.0	
	a_s =	16	29	14.4	
Sideral interval after noon, I	=	2	54	35.6	
Correction sidereal to mean interval	=		0	28.6	
Local mean time eastern elongation	=	2	54	07.0	P. M., Nov. 28.
Local mean time western elongation	=	2	47	36.7	A. M., Nov. 28.

For longitudes west of Washington decrease times of elongation $0^{s}.66$ for each degree.

CHAPTER III.

HORIZONTAL LOCATION

The primary control or geometric work is, in the ordinary case, effected by triangulation. Wherever this is not practicable or not economic, resort is had to what is known as primary traversing, but wherever the country presents sufficient relief for the purpose, triangulation is employed, as it is more accurate and cheaper. In some parts of the country triangulation of sufficiently accurate character for controlling the map has been executed by other organizations, notably by the U. S. Coast and Geodetic Survey, and the U. S. Lake Survey. Wherever such triangulation is available, the results should be adopted and utilized for the control of the maps.

PARTY ORGANIZATION.

The primary triangulation is generally carried on by a special party. It is, however, on some accounts and under certain circumstances, economical and advisable that all the work be done by one and the same party. The disadvantage is that it divides the time and attention of the topographer, requiring him to turn his attention from one thing to another; the advantage, that it insures the selection of such points as are needed by the topographer for carrying forward the work. If the work is done by a special party, the points selected are more likely to be chosen on account of their forming good figures in the triangulation, than on account of their convenience and usefulness to the topographer. The secondary triangulation, the traversing, and the sketching are usually carried on by different men, but under a single party organization. The sketching is done by the chief of party, the secondary triangulation and height measurement by his most experienced assistant, while the traversing, with height measurement, is done by the other assistants.

BASE-LINE MEASUREMENT.

This is, ordinarily, the first of the preparatory steps toward map making. Upon the proper selection of the site of the base line and its correct measurement depends all the subsequent work of triangulation. The site must be reasonably level. It is not essential that it be absolutely so, but the more closely it approaches a plane the less difficulty will be experienced in making an accurate measurement. The site should afford sufficient room for the measurement of a base from 5 to 10 miles in length. A base less than 5 miles in length is not an economical one, inasmuch as it is less costly to extend the base than to complicate the expansion. A greater length than 10 miles is unnecessary, because this length permits of easy expansion, and, if the length be greater than this, it may be difficult to construct signals at the two ends of the base, which will be intervisible.

The ends of the base must be intervisible, and they must be so situated with regard to suitable points for expansion and triangulation as to form well proportioned figures. Whenever possible, the base line should form a side or diagonal of a closed quadrilateral or pentagonal figure.

While it is unnecessary to devote time to obtaining the extreme of accuracy in the measurement of a base, this measurement should be so accurate that its errors can not affect the map, although multiplied many times in the associated triangulation. All necessary precaution should be taken to secure this result.

Various methods and instruments have been employed in the measurement of base lines upon the Geological Survey. At first wooden rods were employed, varnished and tipped with metal. When used in measuring, these were supported upon trestles and contacts made between them, with considerable refinement. The advantage of using these rods consisted in the fact that their length is but slightly affected by temperature, which is the main source of error in base-line measurement, and being thoroughly varnished they were not greatly affected by moisture.

Subsequently bars of metal were employed of the pattern known as the Coast Survey secondary bars. These consist each of a steel rod between two zinc tubes. As the two metals expand at different rates under changes of temperature, their relative lengths at any temperature as compared to the relative lengths at a normal temperature is, theoretically, an indication of the temperature of the bars at any time. The arrangement for indicating their relative lengths forms a part of the apparatus, and is intended to indicate the temperature of the bars, and thus to afford means of reducing the lengths of the bars to a normal temperature. It has not been found, however, to work well in practice. Besides this, there are other objections to the use of bars of any kind, which may be summarized as follows: First, their use is expensive. A considerable number of men are needed, and as the measurement proceeds slowly it often requires from a month to six weeks to measure and remeasure a base five miles in length. Again, since these bars are but four meters in length, there are many contacts to be made in each mile of measurement, and each contact affords the possibility of a trifling error.

In view of these objections and of certain positive advantages which the change would produce, it was decided, in 1887, to drop the use of bars in the measurement of base lines, and to adopt in their place long steel tapes. By their use it has been found easy to attain the required degree of accuracy in measurement, inasmuch as the number of contacts is reduced to a small fraction of the number necessary in the use of bars, while the uncertainty in regard to the temperature of the measuring apparatus is reduced to a minimum by carrying on the measurement at night or in cloudy weather. The expense of the measurement is greatly reduced. Fewer men are required. The work of preparing the ground and the work of measuring are much lessened, and the rapidity of measuring is increased manyfold. The diminished cost makes it practicable to measure much longer bases, thus diminishing the number of stations required in the expansion. It allows, also, a measurement of base lines at shorter intervals in the triangulation.

The tape in use has a length of 300 feet. It should be carefully compared, at an observed temperature, with the standard of the U. S. Coast and Geodetic Survey, both before and after its use in base measurement. Preferably, the site for the base line should be selected along a railway tangent, as such a location is approximately level, and the railway ties afford an excellent support for the tape. If such a location can not be obtained, it should be selected so as to fill the requirements above mentioned, cleared of brush and undergrowth, and, if necessary, its sharp inequalities should be leveled. The tape should be supported by a series of low stools, whose legs are pressed into the ground at intervals of not more than 25 feet, while similar stools should sustain each end of the tape.

The personnel required in the measurement of a base line is, in an ordinary case, as follows:

First. The chief of the party, who exercises a general supervision over the work, marks the extremities of the tape and provides the necessary precautions against errors in the measurement, as hereafter stated.

Second. The rear chainman, who adjusts the rear end of the tape to the contact marks and who carries and reads one of the thermometers.

Third. The head chainman, who adjusts the forward end of the tape, exerts the requisite tension upon it, and carries and reads a second thermometer.

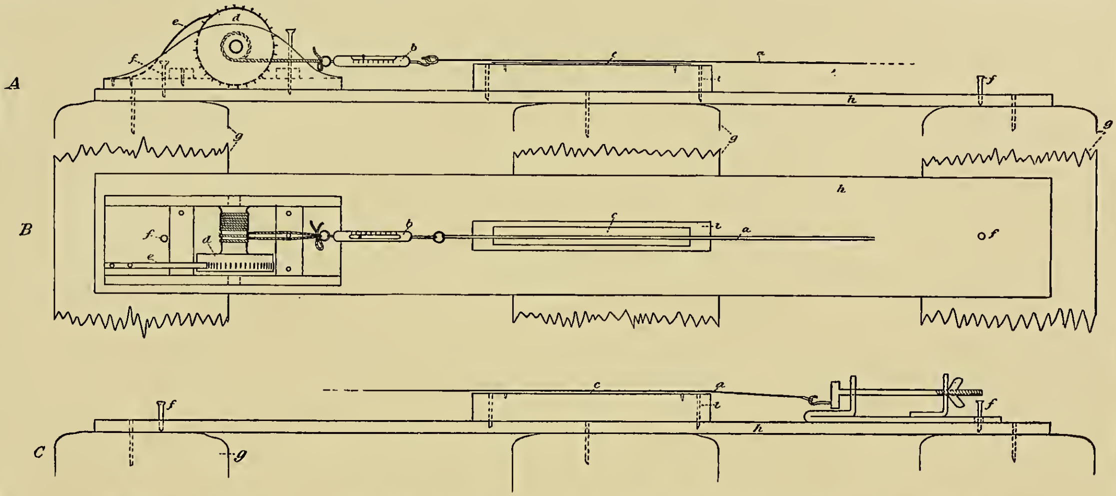
Fourth. A recorder.

The measurement of a base with the steel tape is a simple matter. Provision must, however, be made, first, for the proper alignment of the base; second, for the proper tension of the tape; and, third, for the measurement of temperature.

The alignment is a simple matter, and is generally marked out upon the ground in advance of the work of measurement. In cases where a railway tangent furnishes the site for the base line, no alignment is needed beyond the provision for keeping the tape always at a uniform distance from one of the rails.

For insuring a uniform tension of the tape, an ordinary spring balance is used, which is attached to the forward end of the tape, where a tension of twenty pounds is applied. In order to apply this uniformly, and to insure against slip of the tape, an apparatus devised by Mr. H. L. Baldwin, jr., of the Geological Survey, is in use.

For its use, it is necessary to obtain strips of board about five feet long and four inches in width, in number equal to the number of lengths of tape of which the base line consists. Numbered strips of zinc of equal number, each about eight inches long and an inch in width, are tacked to blocks of wood, and these blocks of wood in turn nailed down upon the boards above



A. Forward end, profile
B " " plan
C. Rear " profile

a. Tape b. Spring balance c Zinc strips d. Cog wheel for straining tape e. Ratchet f. Nail for holding gear in place g. Railroad tie h. Pine strip i Block support for zinc strip

DEVICE FOR STRETCHING TAPE IN BASE MEASUREMENT. DESIGNED AND USED BY
H. L. BALDWIN JR.

mentioned, while the boards are, in case measurement is made along the railway tangent, nailed down to the railway ties. These boards are designed to support the devices for maintaining the tension, and the contacts are marked upon the strips of zinc. Mr. Baldwin's apparatus consists essentially of a wheel worked by a lever and held by ratchets in any desired position. This wheel is attached to the spring balance in such a way that by turning it the strain is put upon the spring balance, which is held at the desired tension by the ratchets. A small mechanism at the rear end of the tape is employed to hold the zero of the tape at the opposite mark. The great length of the tape, 300 feet, allows considerable friction or drag when the supports are frequent, and in order to insure a reasonably uniform distribution of the strain upon the tape, it should be raised and allowed to fall with the strain on.

The measurements should be made at night, or during cloudy days, in order that the temperature of the air, which is that indicated by the thermometers, and that of the tape be as nearly as possible the same. The temperature must be carefully observed by at least two thermometers at each tape length, in order that the best possible data for temperature correction may be obtained.

The base should be measured at least twice, and the two results compared by sections of 1,200 feet, or four tape lengths. The ends of the base must, if possible, be permanently marked by means of stone monuments set into the ground so that their surfaces are but a few inches above its level and the exact position of the ends should be indicated by a cross cut in a copper bolt embedded in the head of a stone, in order that the base may be preserved for future references.

A line of levels must be run over the site or over the stools which support the tape for the purpose of obtaining its profile and thereby the means for deducing its horizontal length.

REDUCTION OF BASE LINE MEASUREMENT.

The first correction to be applied is that of reduction to a standard. The correction for this is obtained by comparison with the standard of the U. S. Coast and Geodetic Survey. The correction for the entire line is in proportion to the correction as obtained by comparison with the standard. If the tape be longer than the standard, the correction will be positive, if shorter, negative.

Second. The correction for inclination, the data for which are obtained by running a line of levels over the base line. This line of levels gives the rise or fall, in feet and decimals of a foot, between the points of change in inclination. From this and the measured distance the angle of inclination is computed from the formula, $\sin \theta = \frac{h}{R}$; R being the distance and h the difference in height, both given in feet. The correction in feet to the distance is then computed by the equation,

$$\text{Corr.} = \frac{\sin^2 1'}{2} \theta^2 R \text{ or } 0.00000004231\ \theta^2 R,\ \theta \text{ being expressed in minutes.}$$

(See Lee's Tables, p 83.)

Third. The correction for temperature. Steel expands for each degree of temperature .0000063596 of its length. This fraction multiplied by the average number of degrees of temperature at the time the base line was measured above or below sixty-two degrees, which is taken as the normal temperature, gives the proportion in which the base line is to be diminished or extended on account of this factor. Care must be taken to obtain correctly this average temperature. It must be the mean of all the thermometric readings, taken at uniform intervals of distance during the measurement. If the temperature be above the normal, the correction is positive, and vice versa.

Fourth. The reduction to sea level. The base line is measured on a circle parallel to the sea surface and raised above it, at an elevation which is known at least approximately. This circle with radii drawn therefrom to the center of the earth forms approximately a triangle similar to that formed by the radii of the earth with the sea surface. The length at sea level is derived with a sufficient approximation to correctness by the proportion:

$$R : h :: K : \text{correction.}$$

R being the radius of the earth, h the mean height of the base line above sea level, and K its measured length. (See Report U. S. Coast and Geodetic Survey, 1882, Appendix 9, p. 19*b*.)

The following is an example taken from the records of measurement in 1889 near Spearville, Kansas, together with the reduction of this base for inclination, temperature, and elevation above sea level:

Record of measurement and reduction of Spearville base, Kansas.

[Section 1. Stations 0–10. October 16, 1889. Light rain falling.]

No. of Tape.	Time, a. m.		Tension.	Thermometers.		Temperature correction.	Total length of section.
				A.	B.		
	h.	*m.*	*Pounds.*	°	°		
1	10	13	19.75	50.5	50.0		
2		20	20.00	50.5	50.0	Mean temp. = 50.51°	
3		26	20.00	50.5	50.0		
4		31	20.25	50.5	50.0		
5		37	20.00	50.7	50.5	62° − 50.51° = 11.49°	
6		42	20.125	51.5	50.6		
7		47	20.25	51.0	50.8	−11.49° × 3000′.	1 tape length .... = 300.0617′
8		51	20.00	50.8	50.2	× .000006	
9		55	20.125	50.8	50.0		10 × 300.0617′ .... = 3,000.617′
10		58	20.00	50.7	50.5	= −.207′	Temperature corr .... −.207
							Result first measurement = 3,000.410

[Second measurement, October 17, 1889.]

No. of Tape.	Time, p. m.		Tension.	Thermometers.		Temperature correction.	Total length of section.
				A.	B.		
	h.	*m.*	*Pounds.*	°	°		
1	12	13	20.00	52.3	52.4		
2		21	20.25	53.3	52.9		Tape set back from sta. 0 .85 inch.
3		25	20.00	53.8	54.0	Mean = 53.96°	= .071 foot.
4		29	19.75	55.0	54.8		
5		33	20.00	55.0	53.2	62° − 53.96° = 8.04°	
6		36	20.00	53.8	54.0		
7		38	20.00	54.0	54.0	− 8.04° × 3000′.	
8		41	20.12	54.5	54.0	× .000006	10 × 300.0617′ .... = 3.000.617′
9		45	19.75	55.1	54.4		Set back .... −.071
10		50	20.13	54.5	54.1	= −.145′	Temperature corr .... −.145
							Result second measurement = 3,000.401

Correction for inclination Spearville base, Kansas.

$$\text{Correction} = \frac{\sin^2 1'}{2} \cdot \theta^2 \times \text{Distance.}$$

Approximate distance.	Difference of elevation.	Angle θ		log θ	2 log θ	log $\frac{\sin^2 1'}{2}$	log dist.	log correction.	Correction.
Feet.	*Feet.*	′	″						
200	0.8	13	34	1.1326	2.2652	2.6264	2.3010	7.1926	.0015
4,200	4.2	2	22	0.3674	0.7348		3.6232	6.9844	.0010
4,000	12.0	10	08	1.0052	2.0104		3.6021	8.2389	.0173
1,000	1.0	3	23	0.5250	1.0501		3.0000	6.6765	.0005
2,000	3.0	5	04	0.7024	1.4049		3.3010	7.3323	.0021
4,200	22.0	12	23	1.0917	2.1834		3.6232	8.4330	.0271
2,800	7.0	8	27	0.9263	1.8527		3.4472	7.9263	.0084
1,000	0.0	0	00	0.0000	0.0000	Constant.	3.0000	0.0000	.0000
1,000	1.0	3	23	0.5250	1.0500		3.0000	6.6764	.0005
4,200	20.0	11	16	1.0504	2.1008		3.6232	8.3504	.0224
3,800	6.0	5	20	0.7267	1.4535		3.5798	7.6597	.0046
2,000	4.0	6	45	0.8293	1.6586		3.3010	7.5860	.0038
5,400	31.4	19	30	1.2934	2.5867		3.7324	8.9455	.0882
2,000	2.6	4	24	0.6437	1.2874		3.3010	7.2148	.0016
135	0.05	1	18	0.1072	0.2144		2.1303	4.9712	.0000
									.1790

Reduction to sea level.

Correction .... = $\frac{K\,h}{R}$
log K (metres) .... = 4.05956
log h (metres) .... = 2.87599
Co log R 3.19660

log 1.356 metres .... = 0.13215
log. metres to feet .... = 0.51599

4.448 feet 0.64814

Spearville base: Summary by sections.

[Corrected for temperature.]

Stations.		First measure.	Second measure.	Difference.
				First—Second.
		′	′	′
1 to	10	3,000.410	3,000.401	+.009
10	20	.418	.393	+.025
20	30	.431	.431	+.000
30	40	.426	.446	−.020
40	50	.437	.478	−.041
50	60	.417	.455	−.038
60	70	.369	.392	−.023
70	80	.366	.356	+.010
80	90	.955	.938	+.017
90	100	.676	.667	+.009
100	110	3,000.899	3,000.898	+.001
110	119	2,700.581	2,700.571	+.010
119	126	2,100.244	2,100.234	+.010
		37,806.629	37,806.660	−.031′=.372″

Mean of 2 measurements .... = *37,806.645′
Reduction from S. W. base to △ .... − 168.235
Reduction from N. E. base to △ .... − 2.864
Correction for inclination .... − 0.179
Reduction to sea level .... − 4.448
Corrected length .... = 37,630.919

PRIMARY TRIANGULATION.

The base line having been measured, the next step is the expansion. This work, as well as the body of the triangulation, consists in the selection of stations, the erection of signals, and the measurement of angles. Each triangle proceeding from the base line outward will, when the angular measurement is completed, have one side and the three angles known, from which the other two sides can be computed by means of a simple trigonometric formula.

The expansion differs from the body of the triangulation only in the fact that the average length of the sides of the triangles is less. As the expansion progresses away from the base line, the sides of successive triangles become gradually longer, until the average length of side of the triangulation is reached. Since the sides are increasing in length, and hence since any inaccuracy in the measurement of the base is multiplied, this work must be planned and executed with greater care than the body of the triangulation requires.

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* Corrected for temperature.

A base line measured as above prescribed requires little expansion, since from the extremities of an 8 or 10 mile base one can observe directly on points 12 to 15 miles away, a distance as great as the average side of a triangle. Ordinarily, from the ends of the base, the surveyor can observe directly upon stations in his scheme of triangulation.

In the western mountain region, where the sides of triangles may be 20 to 50 miles in length, an expansion is required.

SELECTION OF STATIONS.

In the selection of triangulation stations two different sets of requirements must be served.

First. They must be so selected as to afford what is known as strong figures, in order to reduce to a minimum the errors which will creep into an extended system. In order to insure intervisibility, they should, if possible, be located upon hill or mountain summits, the most commanding in the neighborhood. No triangle upon which dependence is placed for the location of a station should have at that station an angle of less than 30° or more than 150°.

The stations should, if practicable, be grouped into simple figures, as quadrilaterals, or pentagons with an interior station, etc. In cases where an area is being covered with triangulation, such groupings naturally occur, but in certain cases the triangulation takes the form of narrow belts of figures, and then the belt may consist of simple triangles or quadrilaterals, as more complex figures are rarely desirable.

Second. Since the sole object of this triangulation is the control of the topographic map, the location of stations must, as far as is consistent with accuracy, be adjusted to the needs of the topographers. This requirement affects most seriously the distance between stations. Every atlas sheet must contain at least two primary stations, and a third is desirable. Thus, for controlling the sheets on the scale 1:62500, the stations should not be more than 10 or 12 miles apart, and should be located with direct reference to the control of certain sheets. Again, since the primary stations must be occupied by topographers for intersecting on numerous points, they must be selected with reference to this requirement. They should command an extended view, especially of points suitable for cutting in, such as hill and mountain summits, houses, churches, etc.

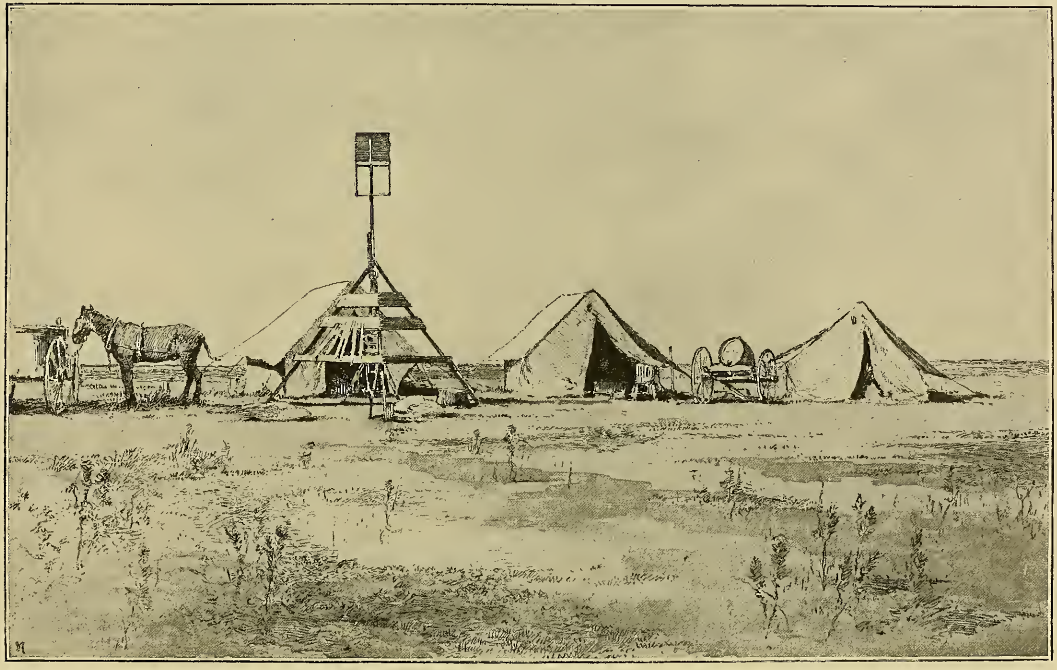
The instrument should, wherever possible, be accurately centered under the signal. Whenever it is necessary to set up off center, the direction and distance to the signal should be carefully measured and recorded.

SIGNALS.

While signals should be of the simplest and least expensive form which will serve the purpose, their form and material must depend upon the requirements and the materials at hand. In a mountainous country, where the summits are treeless, simple cairns of stone, 7 to 10 feet in height, are employed. Where the summits are wooded, it is frequently convenient to clear them, leaving a single tree to serve as a signal. In such cases it is advisable to trim the tree of branches, with the exception of a tuft at the top. Where the station is clear, but with green timber easily accessible, it is advisable to make a tripod of small trees, each with a tuft at its top. In undulating and hill country it is often necessary to erect scaffolds. These should be built of sawed lumber and framed in simple fashion. If the lines are short, a pole with a flag may be set in the top. If the lines are long, the tower itself may serve as a signal, in which case its upper part should be clothed in black and white cotton.

The annexed cut shows a form of framed signals adapted for use on the treeless plains of Kansas and the rolling open hills of New England, and elsewhere, where observing towers are not necessary. (Pl IV.)

It is frequently necessary to raise the instrument to a considerable elevation above the ground, in order to overlook surrounding obstacles. In such cases the structures for supporting the instrument should be combined with the signals, and hence they may properly be described and figured here. These observing towers should be in two parts. An interior structure, solidly built of sawed lumber, if available, for the immediate support of the instrument, and a framework surrounding it, supporting a platform



SIGNAL.

just below the stand for the instrument, for the observer. The two should be separate, in order that the jarring incident to moving about on the platform be not communicated to the instrument. Such a type of observing tower is figured in Fig. 4.

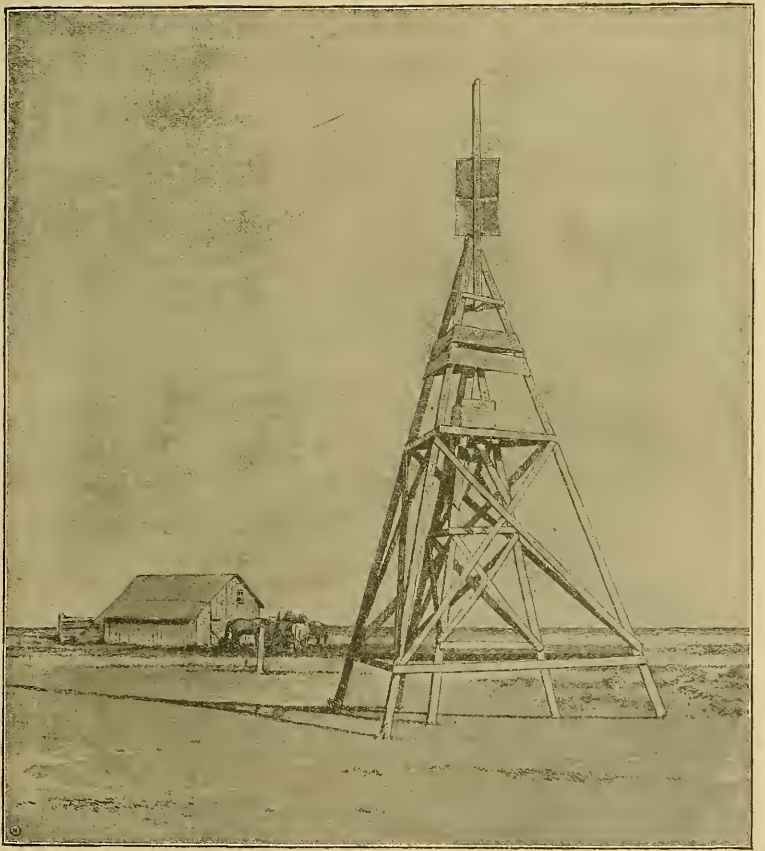


FIG. 4.—Signal and instrument support.

When sawed lumber is not obtainable, other material must be used. In the Sierra Nevada of California, among the sugar-pine forests, a support for the instrument is not unfrequently obtained by sawing off the top of a high tree, and setting the instrument upon the stump, 50 or 75 feet above the ground, the tree being guyed out by wire cables to prevent swaying in the wind. The platform for the observer is supported by neighboring trees, similarly sawed off and supported for the purpose. Similar devices are resorted to also in the forests of West Virginia, Kentucky, and Tennessee. In the secondary triangulation in these regions, the instrument support is, in many cases, provided as above described, while the observer's platform, instead of having an independent support, is attached to the same tree. This is objectionable, but is often the best that can be done.

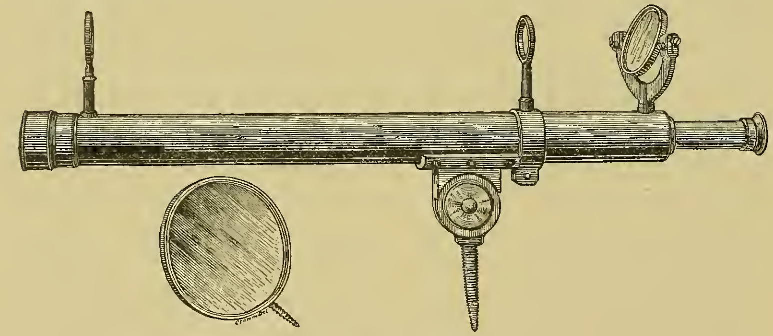


FIG. 5.—Coast Survey Heliotrope.

In other cases it is more economical to support the instrument upon the ground, and to have openings made through the forest upon the station hill, in the directions of the sight lines, or even to have the whole summit cleared.

It is not infrequently necessary to use more elaborate forms of signals, especially when the point observed upon is below the horizon line, so that the background, instead of being the sky, consists of forests or brown plains. In such cases resort is had to heliotropes. These are simply instruments for reflecting the sunlight to the observer at the instrument. The simplest form is a circular mirror with a screw hinged at the back, giving a universal motion. This is screwed into a stake or tripod over the center of the station to be observed upon, and a ray of sunlight is thrown through a small hole in a board nailed to a stake 10 or 15 feet away, and in the direction of the observer at the distant station. This form has the advantage of simplicity, as the simplest backwoodsman can manage it; and the triangulator can firmly fix all range stakes upon one visit to the station, and be sure of seeing the flash as he observes from each of the surrounding stations in turn.

Two other forms are in use, the Coast Survey type and the Steinheil. See Figs. 5 and 6. The former consists of a telescope which is provided with a screw for fastening it into any convenient support or upon the theodolite. Upon the telescope is a mirror and two rings, the axis of the rings as well as the center of support of the mirror being parallel to the line of sight of the telescope. The telescope being directed upon the observing station, the mirror is so turned as to reflect the sunlight through the rings and necessarily to the observing station. In many cases the use of a second mirror is necessary, owing to the relative position of the two stations and the sun, and such a mirror forms a part of the outfit. This form is little used, on account of its liability to get out of adjustment. The Steinheil heliotrope is ac ompact little instrument, which can be carried in a case like a pair of field glasses. It consists of a small sextant mirror, the two surfaces of which are as nearly absolutely parallel as possible. This mirror has a small hole in the center of the reflecting surface. Below this central hole is a small lens in the shaft carrying the mirror, and below the lens is some white reflecting material, as plaster of Paris. The mirror is so mounted that it has four different motions, two about its horizontal axis and two about its vertical axis, each of which can be separately bound or controlled by clamps or friction movements. To use the Steinheil, it is screwed into some wooden upright, as the side of a tree, in such a position that the main axis carrying the lens and plaster of Paris reflector shall be parallel to the sun's rays. The observer standing behind the mirror receives from the rear

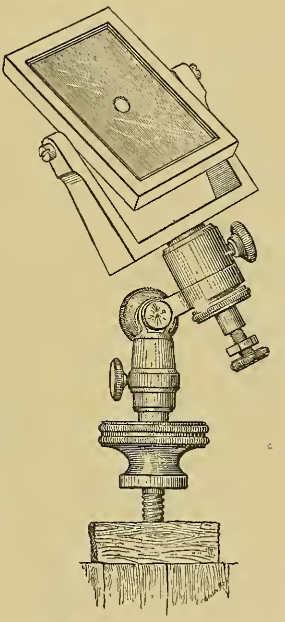


FIG. 6.—Steinheil Heliotrope.

surface of the glass a reflection of the sun, producing an imaginary sun. The mirror should not be moved until this imaginary sun, moving with it, appears to rest on the object to which the flash is to be cast, as the hill on which the triangulator is standing. As both surfaces of the mirror are parallel, the true reflected rays of the sun from the surface of the mirror will also be cast on the object sighted to.

This instrument is in great favor, especially with the Western parties, where portability is a matter of moment, first, because it is light and convenient to carry and use, and second, because there are no movable parts to get out of adjustment by jarring. This latter is a serious defect in the Coast Survey instrument, since unless frequently tested the two rings may have moved, thus causing the reflection to be cast out of parallelism with the line of sight of the telescope.

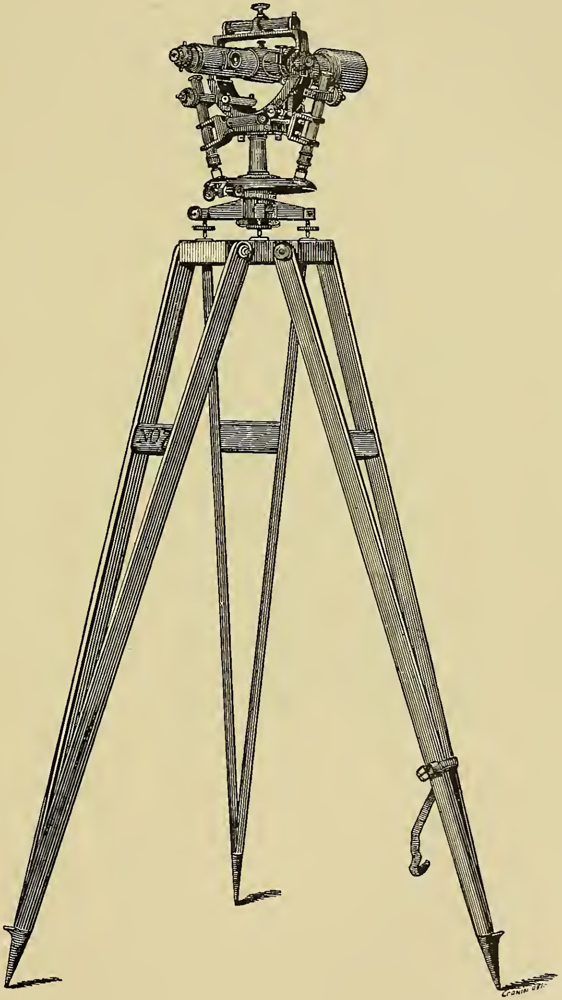
The use of heliotropes presupposes the employment of men to operate them, thus increasing materially the expense of the work. Misunderstandings continually arise between the heliotropers and the observer, causing vexatious delays, and therefore their employment should be avoided whenever possible.

THEODOLITES FOR TRIANGULATION.

Several instruments differing widely in power and degree of accuracy have been in use for the measurement of angles in the primary triangulation. Formerly theodolites having circles 6, 7, 8, 10, and 11 inches in diameter and reading by vernier to 10 seconds were employed, and the results were reduced and adjusted by Least Squares. Subsequently, it appeared desirable to employ a higher class of instruments and thus obtain more accurate results, which would render unnecessary this tedious adjustment. Pursuant to this decision the use of these vernier theodolites has been, in the main, discontinued, and theodolites having 8-inch circles, reading by micrometer microscopes, have been substituted almost universally in the primary work.

One of these theodolites is represented in Pl. V and Fig. 7.

The circle, as was above stated, has a diameter of 8 inches, and is subdivided to 10 minutes. The object glass is 2 inches in diameter and its



EIGHT-INCH THEODOLITE AND TRIPOD.

focal distance is $16\frac{1}{2}$ inches. The telescope with the eyepiece commonly used has a power of about 30 diameters.

The circle is read by means of two microscopes, placed opposite one another. Within the field of the microscope is a comb stretching over the space of 20 minutes. This comb has ten teeth, divided into two parts by a depression, each corresponding to 2 minutes. Parts of a minute down to 2 seconds are read by means of a micrometer screw moving a pair of fine threads in the field of the microscope.

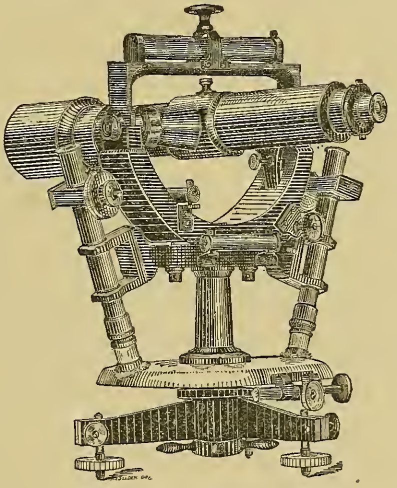


Fig. 7.—Eight-inch Theodolite, detail.

INSTRUCTIONS FOR THE MEASUREMENT OF HORIZONTAL ANGLES.

The following general precautions should be observed in the measurement of all horizontal angles in the primary triangulation.

The instrument should have a stable support, which may be a stone pier, a wooden post, or a good tripod. If a portable tripod is used, its legs should be set firmly in the ground.

The instrument should be protected from the direct rays of the sun by means of an umbrella, or a piece of canvas like a tent fly. It should also be shielded from winds which may jar or twist either it or its support.

The foot screws of the instrument after it is leveled for work should be tightly clamped. Looseness of the foot screws and tripod is a common source of error, especially with small instruments.

The alidade, or part of the instrument carrying the telescope and verniers or microscopes, should move freely on the vertical axis. Clamps should likewise move freely when loosened. Whenever either of these moves tightly, the instrument needs cleaning, oiling, or adjusting.

The observer should always have a definite preliminary knowledge of the objects or signals observed. The lack of it may lead to serious error and entail cost much in excess of that involved in getting such knowledge.

Great care should be taken to insure correctness in the degrees and minutes of an observed angle. The removal of an ambiguity in them is sometimes a troublesome or expensive task.

The errors to which measured angles are subject may be divided into two classes—viz., first, those dependent on the instrument used, or instrumental errors; and second, those arising from all other sources, which, for the sake of distinction, may be called extra-instrumental errors.

The best instruments are more or less defective, and all adjustments on which precision depends are liable to derangement. Hence the general practice of arranging observations in such a manner that the errors due to instrumental defects will be eliminated in the end results. The principal errors of this kind and the methods of avoiding their effects are enumerated below.

Measurements made with a graduated circle are subject to certain systematic errors commonly called periodic. Certain of these errors are always eliminated in the mean (or sum) of the readings of the equidistant verniers or microscopes, and both of the latter should be read with equal care in precise work. Certain other errors of this class are not eliminated in the mean of the microscope readings, and these only need consideration. Their effect on the mean of all the measures of an angle may be rendered insignificant by making the number of individual measures with the circles in each of n equidistant positions separated by an interval equal to $\frac{360^\circ}{mn}$ where m is the number of equidistant verniers or microscopes. Thus, if $m=2$, the circle should be shifted after each measure by an amount equal to $\frac{180^\circ}{n}$, which, for example, is 45° for $n=4$ and 30° if $n=6$. The degree of approximation of this elimination increases rapidly with n. (For specifications as to particular instruments see "Number of sets required and astronomical azimuths" below.) The effect of this class of errors is always *nil* on an angle equal to the angular distance between consecutive microscopes or a multiple thereof. Other things equal, therefore, we would expect the measures of such special angles to show less range than the measures of other angles.

Besides the instrumental errors of the periodic class, there are also accidental errors of graduation. These are in general small, however, in the best modern circles and their effect is sufficiently eliminated by shifting the circle in the manner explained under "Periodic errors" above.

The effect of an error of collimation on the circle reading for any direction varies as the secant of the altitude of the object observed. The effect on an angle between two objects varies as the difference between the secants of their altitudes. This effect is eliminated either by reversing the telescope in its Ys, or by transmitting it without changing the pivots in the Ys, the same number of measures being obtained in each of the two positions of the telescope. The latter method is the better one, especially in determining azimuth, since it eliminates at the same time errors due to inequality of pivots and inequality in height of the Ys.

The effect of the error of inclination on the circle reading for any direction varies as the tangent of the altitude of the object observed. If the inclination is small, as it may always be by proper adjustment, its effect will be negligible in most cases. But if the objects differ much in altitude, as in azimuth work, the inclination of the axis must be carefully measured with the striding level, so that the proper correction can be applied. The following formula includes the corrections to the circle reading on any object for collimation and inclination of telescope axis:

$$c \sec h + b \tan h;$$

$c =$ collimation in seconds of arc,
$b =$ inclination of axis in seconds of arc,
$h =$ altitude of object observed.

Parallax of wires occurs when they are not in the common focal plane of the eyepiece and objective. It is detected by moving the eye to and fro sidewise while looking at the wires and image of the object observed.

If the wires appear to move in the least, an adjustment is necessary. The eyepiece should always be first adjusted to give distinct vision of the cross wires. This adjustment is entirely independent of all others and requires only that light enough to illuminate the wires enter the telescope or microscope tube. This adjustment is dependent on the eye and is in general different for different persons. Hence maladjustment of the eyepiece can not be corrected by moving the cross wires with reference to the objective. Having adjusted the eyepiece, the image of the object observed may be brought into the plane of the cross wires by means of the rack-and-pinion movement of the telescope. A few trials will make the parallax disappear.

When circles are read by micrometer microscopes it is customary to have them so adjusted that an even number of revolutions of the screw will carry the wires over the image of a graduation space. If the adjustment is not perfect, an error of run will be introduced. This may in all cases be made small or negligible, since by means of the independent movements of the whole microscope and the objective with respect to the circle, the image may be given any required size. In making this adjustment some standard space, or space whose error is known, should be used. At least once at each station where angles are read, observations should be made for run of micrometers. An example of such readings is given under sample of field notes below.

Tangent and micrometer screws should move freely, but never loosely. In making a pointing with the telescope the tangent screw should always move against or push the opposing spring. Likewise, bisections with the micrometer wires should be made always by making the screw pull the micrometer frame against the opposing spring or springs.

Extra instrumental errors may be divided into four classes—namely, errors of observation, errors from twist of tripod or other support, errors from centering, and errors from unsteadiness of the atmosphere.

Barring blunders or mistakes, the errors of observation are in general relatively small or unimportant. With practiced observers in angular measurements, such errors are the least formidable of all the unavoidable errors, and their elimination in the end results is usually well nigh perfect. The recognition of this fact is very important, for observers are prone to attribute unexpected discrepancies to bad observation rather than to their much more probable cause. After learning how to make good observations the observer should place the utmost confidence in them, and never yield to the temptation of changing them because they disagree with some preceding observations. Such discrepancies are in general an indication of good, rather than poor, work.

Stations or tripods which have been unequally heated by the sun or other source of heat usually twist more or less in azimuth. The rate of this twist is often as great as a second of arc per minute of time, and it is generally nearly uniform for intervals of ten to twenty minutes. The effect of twist is to make measured angles too great or too small according as they are observed by turning the microscopes in the direction of increasing graduation or in the opposite direction. This effect is well eliminated, in general, in the mean of two measures, one made by turning the microscopes in the direction of increasing graduation and followed immediately by turning the microscopes in the opposite direction. Such means are called combined measures or combined results, and all results used should be of this kind. As the uniformity in rate of twist can not be depended on for any considerable interval, the more rapidly the observations on an angle can be made the better will be the elimination of the twist. The observer should not wait more than two or three minutes after pointing on one signal before pointing on the next. If for any reason it should be necessary to wait longer, it will be best to make a new reading on the first signal.

The precision of centering an instrument or signal over the reference or geodetic point increases in importance inversely as the length of the triangulation lines. Thus, if it is desired to exclude errors from this source as small as a second, one must know the position of the instrument within one-third of an inch for lines a mile long, or within 6 inches for lines 20 miles long. The following easily remembered relations will serve as a guide to the required precision in any case:

1 second is equivalent to 0.3 inch at the distance of 1 mile.

1 second is equivalent to 3.0 inches at the distance of 10 miles.

1 second is equivalent to 6.0 inches at the distance of 20 miles.

1 minute is equivalent to 1.5 feet at the distance of 1 mile.

The notes should always state explicitly where the instrument and signals are and give their coordinates (preferably polar coordinates) if they are not centered.

Objects seen through the atmosphere appear almost always unsteady, and sometimes this unsteadiness is so great as to render the identity of the object doubtful. The unsteadiness is usually greatest during the middle of the day. It generally subsides or ceases for a considerable period between 2 p. m. and sundown. There is also frequently a short interval of quietude about sunrise, and on cloudy days many consecutive hours of steady atmosphere may occur. For the best work, observations should be made only when the air causes small or imperceptible displacements of signals. In applying this rule, however, the observer must use his discretion. Errors of pointing increase rapidly with increase of unsteadiness, but it will frequently happen that time may be saved by counterbalancing errors from this source by making a greater number of observations. Thus, if signals are fairly steady it may be economical to make double the number of observations rather than wait for better conditions.

The best results in a triangulation are to be obtained by measuring the angles separately and independently. Thus, if the signals in sight around the horizon are in order A, B, C, etc., the angles A to B, B to C, etc., are by this method observed separately; and whenever there is sufficient time at the observer's disposal this method should be followed.

Besides measuring single angles, it is desirable to measure independently combined angles—i. e., angles which consist of the sum of two or more single angles. Thus, supposing O to be the observing station and A, B, and C stations sighted on, the observer should measure not only the angles AOB and BOC, but the combined angle AOC. This is necessary not only because this angle may be used directly in the triangulation, but it will be needed in forming conditions for adjusting the angles about the observing station, or the station adjustment, as it is called.

In order to secure the elimination of the errors mentioned above, the following programme must be strictly adhered to:

Pointing on A and readings of both microscopes.

Pointing on B and readings of both microscopes.

Transit telescope and turn microscopes 180°.

Pointing on B and readings of both microscopes.

Pointing on A and readings of both microscopes.

Shift circle by $\frac{180^\circ}{n}$ and proceed as before until n such sets of measures have been obtained.

Then measure the angles B to C, C to D, etc., including the angle necessary to close the horizon, in the same manner.

A form for record and computation of the results is given below.

When repeating instruments are used, the same programme will be followed except that there should be five pointings instead of one on each of A and B, the circle being read for the first pointing on A and the fifth on B, and again for the sixth pointing on B and the tenth on A.

The importance of having the measures of a set follow in quick succession must be constantly borne in mind. Under ordinarily favorable conditions an observer can make a pointing and read the microscopes once a minute, and a set of five repetitions should be made in five minutes or less.

When several stations or signals are visible and a nonrepeating instrument is used, time may be saved without material loss of precision in the angles, by observing on all the signals successively according to the following programme, the signals being supposed in the order A, B, C, etc., as above.

Pointing on A with microscope readings.

Pointing on B with microscope readings.

Pointing on C with microscope readings.

- -

Pointing on A with microscope readings.

Transit telescope and turn microscopes 180°.

Pointing on A with microscope readings.

Pointing on B with microscope readings.

Pointing on C with microscope readings.

- -

Pointing on A with microscope readings.

Shift circle by $\frac{180}{n}$ and proceed as before until n such sets have been obtained.

The angles A to B, B to C, etc., read in this way may be computed as in the first method, always combining the measure A to B with the immediately succeeding measure B to A to eliminate twist. There is a theoretical objection to this process of deriving angles founded on the fact that they are not independent, but in secondary work this objection may be ignored as of little weight.

For the 11-inch theodolite and for the new 8-inch instruments made by Fauth & Co., all of which read by micrometer microscopes, four (4) sets of measures on as many different parts of the circle will be required; and for the repeating theodolite six (6) sets of measures will be required, all measures being made according to the programmes given above.

Under ordinary circumstances and with due care in centering, angles measured as specified above should show an average error of closure of the triangles not exceeding 5″.

Under specially unfavorable conditions the number of sets of measures should be increased, care being always taken to shift the circle so as to eliminate periodic errors.

The practice of starting the measurement of an angle or series of angles with the microscopes reading 0° and 180°, 90°, and 270°, etc., must be avoided; otherwise the errors of these particular divisions will affect many angles. In shifting the circle it is neither necessary nor desirable to have the new positions differ from the preceding one by exactly $\frac{180}{n}$. A difference of half a degree either way is unimportant as respects periodic errors, and it is advantageous to have the minutes and seconds differ for the different settings.

Field notes should be clear and full. The date, place, name and number of instrument used, and the names of observer and recorder should be recorded at the beginning of each day's work at a station. The positions of the instrument and signals observed should be defined either by a full statement or reference to such in each day's notes. The time of observations should be noted at intervals to show that the instrument does not stand too long between pointings.

When mistakes are made in the record, the defective figures should not be erased, but simply crossed out, and an explanation furnished in the column of remarks. Great care should be taken not only to avoid "cooking" or "doctoring" notes, but to avoid suspicion thereof.

The following example of form of record is taken from the primary triangulation executed in 1889 in western Kansas:

Record of measurement of horizontal angle.

[Station: Township corner, Kansas, July 1, 1889. Fauth 8-inch theodolite No. 362, one division of micrometer head = 2 seconds.]

Station.	Micr. A.			Micr. B.			Mean reading.			Angle.			Mean.
	Telescope direct.												
	°	′	*Div.*	°	′	*Div.*	°	′	″	°	′	″	″
Walton	93	12	11.3	273	12	09.9	93	12	21.2	36	29	03.9	
Newt	129	41	11.9	309	41	13.2	129	41	25.1				05.9
Newt	129	41	15.6	309	41	12.1	129	41	27.7			08.0	
Walton	93	12	10.6	273	12	09.1	93	12	19.7				
	Telescope reversed.												
Walton	138	27	03.2	318	26	28.0	138	27	01.2				
Newt	174	56	02.8	354	55	28.9	174	56	01.7			00.5	
Newt	174	56	06.2	354	55	29.5	174	56	05.7				01.8
Walton	138	27	05.2	318	26	27.4	138	27	02.6			03.1	
	Telescope reversed.												
Walton	183	07	03.0	3	06	27.2	183	07	00.2				
Newt	219	36	05.0	39	35	29.8	219	36	04.8			04.6	
Newt	219	36	08.1	39	35	29.5	219	36	07.6				03.9
Walton	183	07	06.4	3	06	28.1	183	07	04.5			03.1	
	Telescope direct.												
Walton	228	24	28.1	48	24	22.6	228	24	50.7				
Newt	264	53	27.4	84	53	26.1	264	53	53.5			02.8	
Newt	264	54	01.1	84	53	26.1	264	53	57.2				04.3
Walton	228	24	29.3	48	24	22.1	228	24	51.4			05.8	

4 | 15″.9

Mean of 4 combined measures* .... =36° 29′ 03″.98

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* Instrument over center of station.

ORGANIZATION OF PARTIES AND PROSECUTION OF WORK.

A party for carrying on primary triangulation usually comprises only the chief and an assistant, with the addition of a driver and cook, in case the party is living in camp. Frequently, however, a man is employed to superintend the construction of signals, and it is generally found economical to employ such a man. The chief of the party is expected to select the stations and direct the forms of signals to be erected, and to measure angles. In a mountainous country the selection of stations is usually a simple matter. From the summit of a mountain the chief of a party may be able to select stations for considerable distances ahead and to order the erection of signals, turning over to the man employed for that purpose the business of erecting them. On the other hand, in a densely wooded region such as the Cumberland plateau, where the summits have approximately the same elevation, the selection of stations is an extremely difficult matter, requiring great ability and experience and involving an immense amount of labor. In such a region the chief of party finds it necessary to travel great distances, visit many hills, and even has to climb to the summits of the highest trees, in order to select intervisible stations.

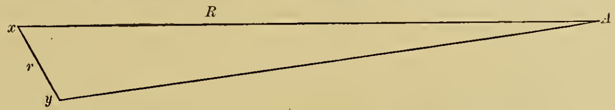
The selection of stations must be kept in advance of the reading of angles, but it is not advisable to keep it too far ahead, on account of the danger of the destruction of signals before angles have been read upon them. Therefore, the chief of a party finds it necessary to alternate between the two kinds of work, selecting and preparing three or four stations, then returning and measuring the angles.

When it is necessary to use heliotropes, the party has necessarily to be increased by one man for each heliotrope employed. The proper management of such a party then becomes a matter calling for the exercise of much judgment on the part of the triangulator. If it is convenient for the chief of party to place each heliotroper before observing angles, and to show them where to direct their instruments, men of ordinary intelligence may be employed and the work is one calling rather for time than skill. Where, however, the party is moving almost daily, the observer and heliotropers occupying a different station nearly every day, as is possible in the dry and clear atmosphere usually prevailing in the West, the chief of party has to arrange a schedule for each man, showing the order in which he is to occupy the stations and in what direction he is to flash from each. The heliotroper must be a man having some topographic and technical skill, so that he may find his point, set up on center and direct his flashes to the right place, besides exercising a goodly amount of common sense judgment. A simple code of signals being agreed upon, it then becomes an easy matter for the triangulator to let the heliotropers know that the work is completed, when they at once move to the next designated station.

REDUCTION OF PRIMARY TRIANGULATION.

*REDUCTION TO CENTER.

In case any station was occupied off center, the directions as read must first be reduced to center. In the diagram, let x be the point occupied; y, the station, r the distance between them, A the point to which the direction is laid and the angle at that point, and R its distance, approximately known. Then, from the relations between the sides and the angles of the triangle,



$$\mathrm{R} : r :: \sin x : \sin \mathrm{A}$$

$$\sin \mathrm{A} = \frac{r \sin x}{\mathrm{R}} \text{ and } \mathrm{A} = (\text{in seconds}) \ \frac{r \sin x}{\mathrm{R} \sin 1''}$$

correction in seconds of arc.

The following example taken from the triangulation in Kansas will serve to illustrate the form of effecting this reduction. The references are to the diagram on page 67.

Reduction to center of station at Walton ⚠.

[See explanation: Appendix No. 9, page 167, U. S. Coast and Geodetic Survey report for 1882.]

distance, inst. to center = ′.48 log = 9.6812
log feet to meters = 0.5160

distance, inst. to center log meters = 9.1652 = log r.

Direction.	x to n 7°.	x to o 73°.	x to p 105°.	x to q 185°.	x to r 273°.	x to s 306°.
log sin angle	9.0859	9.9806	9.9849	8.9403	9.9994	9.9080
Co. log, distance	5.9321	5.9182	6.4228	6.2434	6.0079	6.2514
log r	9.1652	9.1652	9.1652	9.1652	9.1652	9.1652
Co. log sin 1″	5.3144	5.3144	5.3144	5.3144	5.3144	5.3144
	9.4976	0.3784	0.8873	9.6633	0.4869	0.6390
Correction to direction	0″.31	2″.39	7″.71	0″.46	3″.06	4″.36

″ ″ ″
Correction to angle $a = n$ to o −0.31 +2.39 = +2.08
$b = o$ to p −2.39 +7.71 = +5.32
$g = n$ to p −0.31 +7.71 = +7.40
$c = p$ to q −7.71 −0.46 = −8.17
$d = q$ to r +0.46 −3.06 = −2.60
$e = r$ to s +3.06 −4.36 = −1.30
$h = q$ to s +0.46 −4.36 = −3.90
$f = s$ to n +4.36 +0.31 = +4.67

The angles are measured on a spherical surface and the sum of the three measured angles of each triangle should equal 180° plus the spherical excess. The latter need be computed and subtracted from the sum of the angles, however, only for the purpose of testing the accuracy of closure of the triangle, as in the reduction the angles are treated as plane angles. When the area of the triangle is large, the spherical excess in seconds (E) should be computed by the equation:

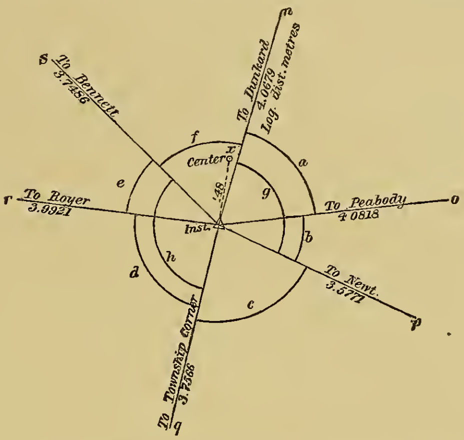
$$E = \frac{S}{r^2 \sin 1''}$$

where $S =$ the area of the triangle in square miles, and r the radius of curvature of the earth in miles. When the triangle (being within the United States) has an area less than 500 square miles, r may be assumed as constant, and the spherical excess may be obtained by dividing the area in square miles by 75.5.

The next step is the adjustment of the angles about the observing station, or the station adjustment, as it is called. Referring to the diagram, which represents the angles read at Walton station, in Kansas, it is seen that eight angles were measured as follows—

	Obs. angle.			Station adjustment.	Correction to center.	Angles locally adjusted and reduced to center.		
	°	′	″	″	″	°	′	″
a Dunkard—Peabody	65	45	28.37	+.51	+2.08	65	45	30.96
b Peabody—Newt	31	47	58.50	+.52	+5.32	31	48	04.34
Sum =	97	33	26.87	....	....	97	33	35.30
g Dunkard—Newt (meas.)	97	33	28.39	—.49	+7.40	97	33	35.30
Difference =			—1.52	....	....			00.00
d Township cor.—Royer	87	44	57.41	—.56	—2.60	87	44	54.25
e Royer—Bennett	34	00	03.35	—.56	—1.30	34	00	01.49
Sum =	121	44	60.76	....	....	121	44	55.74
h Township cor.—Bennett	121	44	59.05	+.59	—3.90	121	44	55.74
			+1.71	....	....			00.00
f Bennett—Dunkard	61	09	26.17	+.02	+4.67	61	09	30.86
g Dunkard—Newt	97	33	28.39	—.49	+7.40	97	33	35.30
c Newt—Township cor	79	32	06.25	+.02	—8.17	79	31	58.10
h Tp. corner.—Bennett	121	44	59.05	+.59	—3.90	121	44	55.74
Sum =	359	59	59.86	....	....	360	00	00.00
			—0.14	....	....			00.00

Of these $a + b$ should $= g$, $d + e$ should $= h$, and $g + c + h + f$ should $= 360°$. Thus are formed in this case three conditions affecting eight unknown quantities. The method by which are found the corrections which fulfill these conditions is that known as the method of Least Squares. It is unnecessary to explain the theory of this method, but only to show how it is applied in the class of cases under consideration, which can best be done by tracing a case through. There are here three equations of conditions, as follows:


n
To Dunkard
4.0679
Log. dist. metres
s
To Bennett
3.7486
r
To Royer
3.9921
To Peabody
4 0818
o
To Newt.
3.5771
p
To Township Corner
3.7566
q
x
Center
'48
Inst.
a
b
c
d
e
f
g
h

$$
\begin{aligned}
&(1)\ a + b - g - 1''.52 &= 0\\
&(2)\ d + e - h + 1''.71 &= 0\\
&(3)\ f + g + c + h - 0''.14 &= 0
\end{aligned}
$$

in which the letters represent, not, as in the diagram, angles, but unknown corrections to the angles. The coefficient of each of these corrections is unity. Arrange them in tabular form, the numbers at the top referring to the equations, thus forming what is called a table of correlates. Now multiply each coefficient by itself and every other in the same horizontal line, and sum them. There result three normal equations, as follows:

	w	y	z
a	1		
b	1		
c			1
d		1	
e		1	
f			1
g	−1		1
h		−1	1

$$
\begin{array}{lrrrrl}
1 & +3.00w & & -1.00z & -1''.52 & = 0\\
2 & & +3.00y & -1.00z & +1''.71 & = 0\\
3 & -1.00w & -1.00y & +4.00z & -0''.14 & = 0
\end{array}
$$

These three equations involving three unknown quantities, are then solved by elimination, with results as follows:

$$\begin{aligned} w &= +\overset{\prime\prime}{.}515 \\ y &= -.562 \\ z &= +.023 \end{aligned}$$

These values can now be substituted in the table of correlates, columns 1, 2, 3; the algebraic sum of lines *a*, *b*, *c*, *d*, etc., giving corrections to the angles *a*, *b*, *c*, *d*, etc.

	1	2	3	Corrections to angles.
				″
a	+.515			+.515
b	+.515			+.515
c			+.023	+.023
d		—.562		—.562
e		—.562		—.562
f			+.023	+.023
g	—.515		+.023	—.492
h		+.562	+.023	+.585

FIGURE ADJUSTMENT.

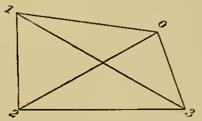
The measurement of the angles having been executed by instruments and methods much better than the needs of the map require, it is not ordinarily necessary to make any figure adjustment, further than an equal distribution of the error of each triangle among the three angles.

Still, as the necessity for a more elaborate adjustment may arise, a description of the method of applying the least square adjustment to geometric figures in triangulation is here given, with a simple example of its application.

Each geometric figure in a system of triangulation is composed of a number of triangles. The measured angles of each triangle should equal 180° plus the spherical excess. Each triangle, therefore, furnishes an equation of condition, which is known as an angle equation. The number of angle equations in any figure is equal to the number of closed triangles into which it can be resolved. But since certain of these are a consequence of the others, the number of angle conditions which it is desirable to introduce is less than the number of triangles.

The number of angle equations in any figure is equal to the number of closed lines in the figure plus one, minus the number of stations. Thus, in a closed quadrilateral, the number of angle equations is $6 + 1 - 4 = 3$.

There is another class of conditions, known as side equations, which can be best explained by reference to a figure. In the example, diagram, suppose the figure 0, 1, 2, 3 to represent the projection of a pyramid, of which 1, 2, 3 is the base and 0 the apex. A geometric condition of such figure is that the sums of the logarithmic sines of the angles about the base, taken in one direction, must equal the similar sums taken in the other direction, *i. e.*, the product of the sines must be equal. In the present case, log. sin 0, 1, 2 + log. sin 0, 2, 3 + log. sin 1, 3; 0 should equal log. sin 1, 2, 0 + log. sin 2, 3, 0 + log. sin 0, 1, 3.



The number of side equations which can be formed in any figure is equal to the number of lines in the figure, plus 3, minus twice the number of stations in it or $l + 3 - 2n$. In a quadrilateral, $6 + 3 - 8 = 1$.

The numerical term in each angle equation is the difference between the sum of the observed angles on the one hand and 180° + the spherical excess on the other. This is positive when the sum of the observed angles is the greater, and vice versa. The coefficients of the unknown corrections are in each case unity, unless weights are assigned.

The numerical term in each side equation is the difference between the sums of the logarithmic sines, taken in the two directions. The coefficients of the unknown corrections are the differences for one second, in the logarithmic sines of the angles.

The method of making up and solving these equations and applying the corrections to the angles can best be shown by means of an example. That here given is the simplest case involving both angle and side equations, namely, the case of a quadrilateral. The method of forming correlatives and normal equations, and their solution, is similar to that employed in station adjustment, and therefore the details are omitted.

In the equations of conditions and correlatives, the angles are designated by directions, to which the corrections are finally applied. Thus the angle of 302 is designated as $- 3/0 + 2/0$, the sign — being given to the left-hand and the sign + to the right-hand direction.

Example of figure adjustment by least squares.

		Observed angles.		
		°	′	″
(a)	3·0·1	120	39	14. 781
	0·1·3	21	26	17. 806
	1·3·0	37	54	37. 180
		180	00	09. 767
	Spherical excess		=	— 0. 148
	Closure error			+ 9. 619
(b)	0·1·2	81	52	51. 222
	1·2·0	62	22	38. 500
	2·0·1	35	44	45. 861
		180	00	15. 583
				— 0. 189
	Closure error			+15. 394
	1·2·3	91	28	38. 000
	2·3·1	28	95	10. 360
	3·1·2	60	26	33. 416
		180	00	21. 776
				— 0. 234
	Closure error		+	21. 542
(c)	2·3·0	65	59	47. 540
	3·0·2	84	54	28. 920
	0·2·3	29	05	59. 500
		180	00	15. 960
			—	0. 193
	Closure error		+	15. 767

Side equation.

[Taking 0 as the pole.]

	Angle.	Log. sines of spherical angle.	Tabular difference for 1″.	Corrections to log. sines.	Corrected log. sines of spherical angles.	Spherical excess.	Log. sines of plane angles.
(d)	0. 1. 2	9. 9956249. 7	+3. 0	—25. 0	9. 9956224. 7	—. 063	9. 9956224
	0. 2. 3	9. 6869340. 0	37. 9	—127. 9	9. 6869212. 1	—. 065	9. 6869210
	1. 3. 0	9. 7884705. 9	27. 0	—1. 2	9. 7884704. 7	—. 050	9. 7884703
	Sum =	29. 4710295. 6			29. 4710141. 5		29. 4710137
	1. 2. 0	9. 9474437. 5	11. 0	—59. 4	9. 9474378. 1	—. 063	9. 9474378
	2. 3. 0	9. 9607184. 9	9. 4	—77. 7	9. 9607107. 2	—. 064	9. 9607107
	0. 1. 3	9. 5628859. 2	53. 7	—203. 0	9. 5628656. 2	—. 049	9. 5628653
	Sum =	29. 4710481. 6			29. 4710141. 5		29. 4710137
	From above	29. 4710295. 6					
	Difference	00. 0000186. 0			000. 0		0000.

(d)..............................$0 = +186.0 - 3.0\,(\frac{0}{1}) + 03.0\,(\frac{2}{1}) - 37.9\,(\frac{0}{2}) + 37.9\,(\frac{3}{2}) - 27.0\,(\frac{1}{3}) + 27.0\,(\frac{0}{3}).$
$-[-11.0\,(\frac{1}{2}) + 11.0\,(\frac{0}{2}) - 9.4\,(\frac{2}{3}) + 9.4\,(\frac{0}{3}) - 53.7\,(\frac{0}{1}) + 53.7\,(\frac{3}{1}).]$

Equations of condition.

(a)..............................$0 = +\ 9''.619 - \frac{3}{0} + \frac{1}{0} - \frac{0}{1} + \frac{3}{1} - \frac{1}{3} + \frac{0}{3}$
(b)..............................$0 = +15\ .394 - \frac{0}{1} + \frac{2}{1} - \frac{1}{2} + \frac{0}{2} - \frac{2}{0} + \frac{1}{0}$
(c)..............................$0 = +15\ .767 - \frac{2}{3} + \frac{0}{3} - \frac{3}{0} + \frac{2}{0} - \frac{0}{2} + \frac{3}{2}$

Collecting terms in (*d*) and dividing through by 100 so as to avoid dealing with large numbers.

(d)..............................$0 = +1.86 + .507\,(\frac{0}{1}) + .030\ \frac{2}{1} - .489\,(\frac{0}{2}) + .379\,(\frac{3}{2}) - .270\,(\frac{1}{3}).$
$+ .176\,(\frac{0}{3}) + .110(\frac{1}{2}) + .094\,(\frac{2}{3}) - .537\,(\frac{3}{1}).$

Table of correlatives.

Direction.	*a.*	*b.*	*c.*	*d.*
0/1	—1	—1	....	+.507
0/2	....	+1	—1	—.489
0/3	+1	....	+1	+.176
1/0	+1	+1	....	....
1/2	....	—1	....	+.110
1/3	—1	....	....	—.270
2/0	....	—1	+1	....
2/1	....	+1	....	+.030
2/3	....	....	—1	+.094
3/0	—1	....	—1	....
3/1	+1	....	....	—.537
3/2	....	....	+1	+.379

Forming the normal equations in the usual manner, we have:

	″				
(*a*)	0=+ 9.619	+6.000	+2.000	+2.000	—0.598
(*b*)	0=+15.394	+2.000	+6.000	—2.000	—1.076
(*c*)	0=+15.767	+2.000	—2.000	+6.000	+0.950
(*d*)	0=— 1.860	—0.598	—1.076	+0.950	+1.054

Solving: we find the following values:

$$
\begin{aligned}
a &= +\ 1.900'' \\
b &= -\ 4.386 \\
c &= -\ 5.208 \\
d &= +\ 3.059
\end{aligned}
$$

Substituting the values of *a*, *b*, *c*, *d*, in the table of correlatives.

Direction.	A.	B.	C.	D.	Correction to each direction.
					″
0/1	—1.900	+4.386	....	+1.551	+4.037
0/2	....	—4.386	+5.208	—1.496	—0.674
0/3	+1.900	....	—5.208	+0.538	—2.770
1/0	+1.900	—4.386	....	....	—2.486
1/2	....	+4.386	....	+0.336	+4.722
1/3	—1.900	....	....	—0.826	—2.726
2/0	....	+4.386	—5.208	....	—0.822
2/1	....	—4.386	....	+0.092	—4.204
2/3	....	....	+5.208	+0.288	+5.496
3/0	—1.900	....	+5.208	....	+3.308
3/1	+1.900	....	....	—1.643	+0.257
3/2	....	....	—5.208	+1.159	—4.049

	Observed angles.	Corrections.	Corrected spherical angles.	Sph. excess.	Plane angles.
	° ′ ″	″ ″	° ′ ″	″	° ′ ″
3.0.1	120 39 14.781	—3.308—2.486	120 39 08.986	—.049	120 39 08.94
0.1.3	21 26 17.806	—4.037+0.257	21 26 14.026	—.049	21 26 13.98
1.3.0	37 54 37.180	+2.726—2.770	37 54 37.136	—.050	37 54 37.08
			180 00 00.148	—.148	180 00 00.00
0.1.2	81 52 51.222	—4.037—4.294	81 52 42.891	—.063	81 52 42.83
1.2.0	62 22 38.500	—4.722—0.674	62 22 33.104	—.063	62 22 33.04
2.0.1	35 44 45.861	+0.822—2.486	35 44 44.194	—.063	35 44 44.13
			180 00 00.189	—.189	180 00 00.00
1.2.3	91 28 38.000	—4.722—4.049	91 28 29.229	—.078	91 28 29.15
2.3.1	28 05 10.300	—5.496—2.726	28 05 02.138	—.078	28 05 02.06
3.1.2	60 26 33.416	—0.257—4.294	60 26 28.865	—.078	60 26 28.79
			180 00 00.232	—.234	180 00 00.00
2.3.0	65 59 47.540	—5.496—2.770	65 50 39.274	—.064	65 59 39.21
3.0.2	84 54 28.920	—3.308—0.822	84 54 24.794	—.064	84 54 24.73
0.2.3	29 05 59.500	+0.674—4.049	29 05 56.125	—.065	29 05 56.06
			181 00 00.193	—.193	180 00 00.00

For a full discussion of the Method of Least Squares and its application to triangulation see "A Treatise on the Adjustment of Observations, by T. W. Wright, B. A.," pp. 250–370. New York. D. Van Nostrand. 1884.

COMPUTATION OF DISTANCES.

In each triangle, starting with the base line, there is known at least one side and the three angles. The remaining sides are computed by the well-known proportion of sides to sines of opposite angles, or expressed mathematically, $a = \frac{b \sin A}{\sin B}$. In this computation distances should be used in meters, and seven place logarithms should be employed.

The following is an example of the correction of the angles and the computation of the sides of triangles taken from the work in Kansas:

Station.	Angles locally adj. and reduced to center.	⅓ error.	Plane angles.	Log sines.
	° ′ ″	″	° ′ ″	
Township corner	36 29 04.0	+ .5	36 29 04.5	0.2257704
Newt	63 58 56.2	+ .6	63 58 56.8	9.9535952
Walton	79 31 58.1	+ .6	79 31 58.7	9.9927124
	179 59 58.3 Error = -1.7			

Log dist. Newt-Walton	3.5771611
Log sin Newt	9.9535952
a. c. log sin Township corner	0.2257704
Log dist. Township corner—Walton	3.7565267
Log dist. Newt-Walton	3.5771611
Log sin Walton	9.9927124
a. c. log sin township corner	0.2257704
Log dist. Township corner—Newt	3.7956439

COMPUTATION OF GEODETIC COORDINATES.

The next step is the computation of the latitude and longitude of the stations and the azimuth or direction of the lines connecting them. Initially, the latitude and longitude of some point is determined by astronomical observations, and this point is connected with the triangulation. The azimuth, or angle with a south line, of a line connecting this point with some station in the triangulation is also determined by astronomical observations. These, with the observed angles and the computed distances between the stations, form the data from which the latitudes and longitudes of the stations and the azimuths of the lines connecting them are computed. The difference in latitude between two adjoining stations is obtained from the following equation, based upon the Clarke spheroid:

$$-dL = K \cos a' \, B + K^2 \sin^2 a' \, C + (dL)^2 D - hK^2 \sin^2 a' \, E,$$

in which

dL is the difference in latitude.

K, the distance between the stations in meters.

a', the fore azimuth of the line connecting them, measured round clockwise from the south through the west.

h, the first term.

δL, the approximate difference in latitude, being the sum of the first two terms.

B, C, D, and E, constants derived from the dimensions and figure of the earth.

These are given for various latitudes in tables at the close of the volume.

The difference in longitude is obtained by means of the following formula:

$$dM = \frac{K \sin a' \, A'}{\cos L'}$$

in which

dM is the difference in longitude.

L', the newly determined latitude.

A', a constant, from tables near the end of the volume, and the others as above.

The azimuths at the two ends of a line differ from one another, on account of the convergence of the meridians. That first determined is known as the fore azimuth, the other, the back azimuth. All azimuths are measured from the south point around to the right.

The back azimuth is computed from the formula:

$$-da = dM \frac{\frac{\sin (L+L')}{2}}{\cos \frac{1}{2} dL}$$

where M is the longitude of the first station.

L, the latitude, and

L′ the latitude of the second station.

The constants used are those of the Clarke spheroid of 1866.

These formulæ are derived and explained in Appendix No. 7, Report U. S. Coast and Geodetic Survey for 1884.

The following are examples of the use of the formulæ, taken from the triangulation in New Mexico :

		°	′	″
Azimuth a:	Nell—Chusca.	159	29	08.728
Spherical angle:		120	54	13.980
Azimuth a′:	Nell—Zuni.	38	34	54.748
δ a + 180°		179	50	02.124
Azimuth (a):	Zuni—Nell.	218	24	56.872

GEODETIC COORDINATES.

LATITUDE.	°	′	″		LONGITUDE.	°	′	″
L:	35	25	13.443	Nell. Geo. Pos. No. 5.	λ:	108	37	24.925
δ L		—17	47.546		δλ	+	17	15.360
L′	35	07	25.927	Zuni. Geo. Pos. No. 6.	λ′	108	54	40.285

Computation for latitude:

log. K	4.6236305
" B	8.5111933
" cos a′	9.8930500
log (I)	3.0278738
log. K²	9.24726
" C	1.25696
" sin² a′	9.58986
log. (II)	0.09408
log. D	2.3679
" [I+II]²	6.0568
log. (III)	8.4247
log. E	6.0124
" K² sin² a′	8.8371
" (I)	3.0279
log. (IV)	7.8774

	″
(I)	1066.286+
(II)	1.242+
(III)	.026+
(IV)	.008—
—δL	1067.546+

[I+II]	1067.528
log. "	3.0283792
" [I+II]²	6.0567584

Computation for longitude:

log. K	4.6236305
" sin a′	9.7949286
" A′	8.5092394
" sec. L′	0.0872944
Corr. for diff. arc. & sine =	— 15
log. (V)	3.0150914
δλ	1035″.360

Computation of azimuth:

log. (V)	3.015091
" sin $\left(\frac{L+L'}{2}\right)$	9.761522
" sec. $\left(\frac{\delta L}{2}\right)$	0.000001
log. (VI)	2.776614
δ a	— 597″.876
	— 9′ 57″.876

Azimuth check.

Check:
Spher. angle
at

Computation of Azimuth a, in Book , page .
Spherical angle and distance = K, in Book , page, Triangle No.
Station; Computed by .

		°	′	″
Azimuth a:	Chusca—Nell.	339	21	40.150
Spherical angle:		25	11	38.601
Azimuth a′:	Chusca—Zuni.	4	33	18.751
δ a + 180°		179	57	25.650
Azimuth (a):	Zuni—Chusca.	184	30	44.401

GEODETIC COORDINATES.

LATITUDE.

	°	′	″
L:	35	53	06.746
δ L	—	45	40.818
L′	35	07	25.928

Computation for latitude:

log. K	4.9280539
" B	8.5111594
" cos a′	9.9986260
log. (I)	3.4378393
log. K^2	9.85610
" C	1.26435
" siu^2 a′	7.79982
log. (II)	8.92027
log. D	2.3703
" $[I+II]^2$	6.8757
log. (III)	9.2460
log. E	6.0214
" $K^2 \sin^2$ a′	7.6559
" (I)	3.4378
log. (IV)	7.1151
(I)	2740″.560+
(II)	.083+
(III)	.176+
(IV)	.001−
−δ L	+2740.818

Chusca.
Geo. Pos. No. 4.

Zuni.
Geo. Pos. No. 6.

[I+II]	2740.643
log. "	3.4378525
" $[I+II]^2$	6.875705

LONGITUDE.

	°	′	″
λ:	108	50	14.518
δλ		+ 4	25.768
λ′	108	54	40.286

Computation for longitude:

log. K	4.9280539
" sin a′	8.8999280
" A′	8.5092394
" sec. L′	0.0872944
Corr. for diff. arc & sine	−129
log. (V)	2.4245028
δλ	+265″.768

Computation of azimuth:

log. (V)	2.424503
" sin $\left(\frac{L+L'}{2}\right)$	9.764002
" sec. $\left(\frac{\delta L}{2}\right)$	0.000009
log. (VI)	2.188514
δ a	— 154″.350
	—2′ 34″.350

Azimuth check:

	°	′	″
	218	24	56.872
	184	30	44.401
Check:	33	54	12.471
Spher. angle at Zuni	33	54	12.469

Computation of Azimuth a, in Book 67, page 4.
Spherical angle and distance = K, in Book 64, page 12, Triangle No. 3.
Station; Computed by H. M. W.

When the lines are not more than twenty miles in length, the equation for latitude may be simplified without appreciable error by dropping the last two terms.

TRAVERSE LINES FOR PRIMARY CONTROL.

In level country, especially if it is covered with forests, it is very expensive to carry on triangulation, and in some cases practically impossible to do so. Under such circumstances the only means of obtaining an adequate control for maps is by means of traverse lines.

A traverse line consists of a series of direction and distance measurements. Each course, as the direction and the accompanying distance are called, depends upon the one immediately preceding it, and a continuous chain is thus formed. Traverse lines are largely used in the topographic work proper for making minor locations. The primary traverse differs from these only in the fact that it is much more elaborately executed.

The initial point of a primary traverse must be located either by triangulation or by astronomic determinations. The end of the line should, if possible, be a point similarly well located. The line should, if practicable, follow a railroad, in order to obtain the easiest possible grades, and thus avoid errors incident to slope.

The instrument used for measuring directions should have a circle 6 to 8 inches in diameter, and should read by vernier to 10 seconds. The theodolites formerly used in the primary triangulation are generally used in this work. A larger or more elaborate instrument is not advisable on account of the difficulties of transporting it and frequently setting it up. Upon short lines instruments reading to minutes may be used.

The readings should be upon signals consisting of poles, and fore and back rodmen must be employed for carrying and setting them. The angular measurements between the poles should be read by both verniers, and it is advisable to note the compass readings at the same time, in order to avoid gross errors. At intervals of 10 to 20 miles, depending upon the number of courses to a mile, observations should be made for azimuth, observing for this purpose upon the pole star, preferably at elongation.

The measurements of distance are effected by the use of steel tapes, and preferably by 300-feet tapes, similar to those used in measuring base lines. Two chainmen should be employed, and in order to avoid errors in the count, it is well to count the rails, in case the work is done upon railroad tracks.

The temperature should be noted by means of thermometers at frequent intervals, in order that the proper corrections may be applied.

The errors incident to running primary traverses are of two classes: errors of direction and errors of distance.

Those of direction are similar to those treated of under the head of Instructions for the Measurement of Horizontal Angles, and need not be specified here.

Owing to the necessity of setting up the theodolite at frequent intervals, it is impracticable to observe at each station the series of angles specified in the above-mentioned instructions, and only a single or at the most a double measure of the included angle, with the reading of each vernier, is practicable for the measurement of direction. It is here provided that observations for azimuth upon Polaris should be much more frequent than in triangulation, and thus an absolute correction to the directions is introduced much oftener. At each azimuth station the new astronomic azimuth should be adopted in place of that carried forward, and in case the discrepancy between the two is sufficiently great to involve perceptible error upon the scale of the map, the correction should be uniformly distributed forward from the first station.

In running these traverses all road crossings should be located, as topographic traverses will be run over the roads and will be connected with the primary traverses at these points. All prominent houses or natural features of any kind in sight from the line must be located by intersection, as they will doubtless be used by the topographers for location.

When traversing in a country which has been surveyed by the General Land Office into townships and sections, the crossing of every township and section line should be located, and the directions of the township lines with reference to the line of traverse should be carefully measured in order to establish as close a relation as possible between the traverse line which serves as ultimate control, and the township system of surveys, which serves as a secondary control.

Lines of traverse exceeding 100 miles in length should be reduced by computation. The distances should be corrected for error of tape, for temperature, and slope, and should be reduced to sea level, in the same manner as above described in treating of the reduction of base lines, in case these corrections are of sufficient amount to affect the length appreciably upon the map.

The courses should be corrected for convergence of meridians. Then, commencing at the initial point, the latitude and departure of each station, one from another, should be computed in feet. The sum of the latitudes converted into seconds of latitude gives the difference in latitude, and the sum of the departures converted into seconds of longitude gives the difference in longitude.

Short lines of traverse may be platted with minute reading protractors, but in this platting the utmost care should be exercised.

PRIMARY ELEVATIONS.

The initial elevations of this work are derived from various sources. Any trustworthy results known to be of a sufficient degree of accuracy for the purpose may be adopted. Whenever elevations have been determined within the area to be surveyed by the United States Coast and Geodetic Survey or the United States Lake Survey, they may be accepted without question. The work of these organizations has been sketched in the early part of this volume and is shown upon map No. 1.

When these determinations are not available, initial bench marks should, if possible, be obtained from the profiles of railroads traversing the district. These have been adjusted and the results published in the Dictionary of Altitudes (Bulletin No. 76, U. S. Geological Survey). In case there are no railroads to furnish initial datum points, as may occur in the sparsely settled regions of the West, or the profiles available are regarded as untrustworthy, it may become necessary to use barometric observations. Where a series of these, of a year or more in length is available, the result may be regarded as sufficiently trustworthy for this purpose.

In regions where secondary triangulation is practicable the measurement of heights may be taken up with the plane table directly from datum points, as above indicated, and carried throughout the work by means of this instrument. Otherwise it becomes necessary to do more or less leveling in order to extend and multiply datum points to control the less accurate work connected with the traversing. If practicable, the wye level should be employed.

The extent of the work of the wye level which may be required depends mainly upon the contour interval of the map to be made. It may be said in general, that a single line across a sheet will furnish a sufficient number and a suitable distribution of points for the proper correction of the subsequent work. Wherever practicable such lines should be run along railroads, in order to obtain easy grades and thus lighten the work. When railroads are not available, they should be run along wagon roads, selecting, so far as they will suit the purpose, those having the easiest grades and the straightest courses.

Where the control of the map is effected by means of primary traversing, such traverse should be accompanied by a level line, unless that of the railroad which the traverse follows appears to be of sufficient accuracy.

CHAPTER IV.

SECONDARY TRIANGULATION.

The work of making secondary locations by intersection is done mainly by plane table. The use of the theodolite for this purpose is restricted to those cases where but little of this kind of location can be effected, and where, therefore, it seems scarcely worth while to prepare plane-table sheets.

By means of the primary triangulation, two or three points are usually located upon each atlas sheet. Within this primary triangulation, and depending upon it, are then located a large number of points, either by intersection, by traverse, or by both methods, forming a geometric framework upon which the sketching of the map depends.

Location by intersection should be carried as far as practicable—that is, all points capable of being located in this manner should be so located in order to afford the most ample control possible for the traverse lines, by which the intervening areas are to be filled in, it being understood that the location by intersection is more accurate and more rapid, and consequently in every way more economic, than location by traverse.

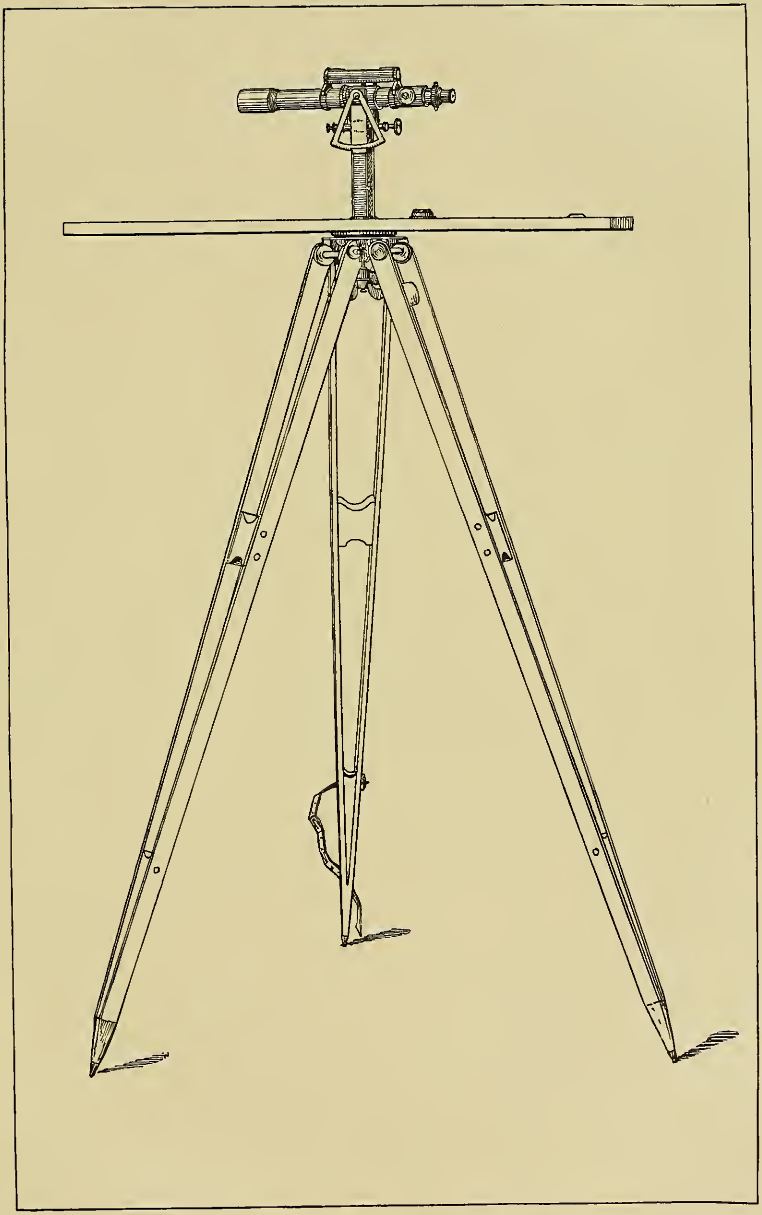
THE PLANE TABLE.

Much misapprehension exists, especially in this country, regarding the character and application of this instrument. This arises, apparently, from the fact that it is little known. For making a map the plane table is a universal instrument. It is applicable to all kinds of country, to all methods of work, and to all scales. For making a map it is the most simple, direct, and economic instrument; its use renders possible the making of the map directly from the country as copy, and renders unnecessary the making of elaborate notes, sketches, photographs, etc., which is not only more expensive, but produces inferior results.

The plane table is essentially very simple, consisting of a board upon which is fastened a sheet of drawing paper. This board is mounted upon a tripod, which, in the more elaborate forms of the instrument, possesses great stiffness and stability. It should be capable of being leveled, of being turned in azimuth, and of being clamped in any position. Upon the paper is produced directly in miniature a representation of the country. When set up at various places within the area in process of being mapped, the edges of the board must always be placed parallel to themselves—that is, a certain edge of the board must always be set at the same angle with the north and south line. This is called orienting the board.

Directions are not read off in degrees and minutes, but platted directly upon the paper. The instrument used for this purpose is known as the alidade, and consists of a ruler with a beveled edge, to which are attached for rough work two raised sights, and for the higher class of work a telescope turning on a horizontal axis. This telescope carries also a delicate level and a vertical arc for the measurement of angles in the vertical plane, from which relative heights are obtained. The method of using this instrument is extremely simple in principle, and becomes difficult in practice only when a high degree of accuracy is required.

The work of making locations from intersections obtained by means of the plane table requires that the instrument have the utmost stability consistent with lightness and portability. It requires an alidade equipped with a telescope of considerable power and good definition. In short, it requires that the plane table be in every respect of the best modern type in order that the highest degree of accuracy possible to represent upon the paper be attained. Various forms of plane-table movement have been in use, including the heavy and cumbersome but stable movement of the Coast and Geodetic Survey, and the light but unstable movement used by the same organization in its less important work. At present a table is in general use which was invented by Mr. W. D. Johnson, of this Survey, which combines the elements of stability, lightness, and facility of operation in a remarkable degree. (See Fig. 8.) This movement is essentially an adaptation of the ball-and-socket principle, so made as to furnish the largest practicable amount of bearing surface. It consists of two cups, one set inside the other,



JOHNSON PLANE TABLE AND TELESCOPIC ALIDADE.

the inner surface of one and the outer surface of the other being ground so as to fit accurately to one another. The inner cup is in two parts, or rather consists of two rings one outside the other, the one controlling the movement in level and the other that in azimuth. From each of these rings there projects beneath the movement a screw, and upon each of these screws is a nut by which it is clamped. There is no tangent screw for either the leveling or the azimuth motion, as none is required. The movement is sustained by a light hard-wood tripod with split legs. The board used generally accommodates a full atlas sheet, but necessarily differs in size, owing to the different scales of field work adopted. The largest board used for this movement holds an atlas sheet upon a scale of 1:45000, and is 24 by 36 inches in size.

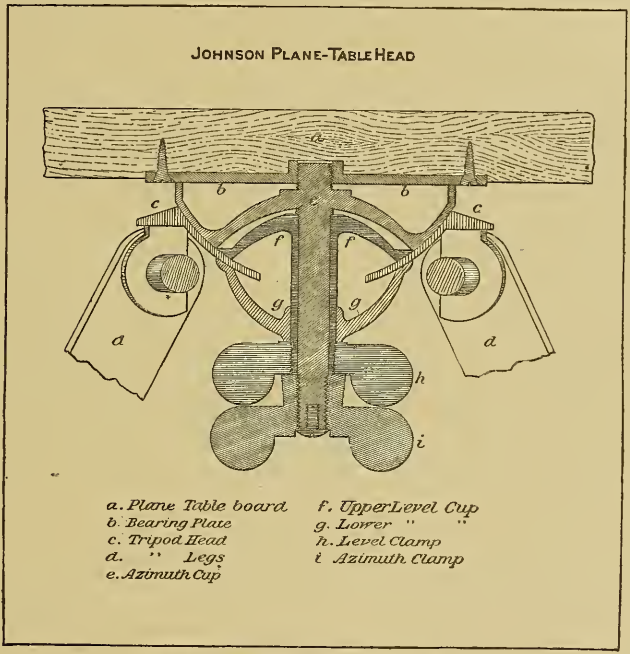

JOHNSON PLANE-TABLE HEAD
a
b
b
c
c
f
f
g
g
d
d
h
i
a. Plane Table board
b. Bearing Plate
c. Tripod Head
d. " Legs
e. Azimuth Cup
f. Upper Level Cup
g. Lower " "
h. Level Clamp
i Azimuth Clamp

FIG. 8.—Johnson plane-table tripod head. Section.

The question of paper for the plane-table sheets, especially in intersection work, is of great importance, as paper which expands and contracts differently in different directions under varying conditions of moisture will easily produce errors of magnitude in the work. It matters little if the paper contracts and expands, provided it does so uniformly in all directions, but all paper is made with more or less fiber, and accordingly expands and contracts more in one direction than in another. To counteract this, two thicknesses of paper are used, preferably that known as Paragon paper, mounted with the grain of the two sheets at right angles to one another, and with cloth between the layers. In sheets so prepared it has been found that there is practically no distortion, even under the most severe tests.

The board is generally made of seasoned white pine, from one-half to five-eighths of an inch thick, with cleats across the ends fastened in such a way as to allow the body of the board to contract and expand freely, and therefore without warping. Into the corners of this board and on the edges at points halfway between the corners are set female screws for holding the paper to the board. At corresponding points in the plane-table sheet are punched holes half an inch in diameter which are lined with eyelets, and through which pass screws with broad heads fitting into the female screws in the board. The holes in the paper, being larger than the screws, allow the paper to expand or contract freely when the screws are loose. When tightened, the broad heads of the screws bind the paper firmly in place.

THE ALIDADE.

The alidade used with this plane table consists of a ruler of brass or steel 18 inches to 2 feet in length, graduated upon a chamfered edge to suit the scale of work, and carrying upon a column a telescope having a focal distance of 12 to 15 inches and a power of about 15 diameters. It has a vertical arc reading by vernier to single minutes, and a delicate level upon the telescope. In some alidades there is an adjustment to make the zeros of the vertical arc and the vernier coincide, when the telescope is horizontal, while in others it is necessary to read the index error of the vertical arc and correct for it, there being no such adjustment. The telescope turns in a sleeve, for adjustment of vertical collimation.

Upon the plane-table sheet is constructed a projection upon the scale of the field work, and upon that are platted such of the primary points as fall upon the sheet, each plane table sheet being made to correspond to an atlas sheet. These primary points are first occupied by the plane tabler.

The instrument is set over one of these stations, leveled, and clamped. The ruler edge of the alidade is then laid upon the line connecting this station with a neighboring one upon the sheet, and the table turned until the other station is upon the vertical wire in the telescope. The instrument is then oriented, and, after clamping in azimuth, is ready for work. Keeping the ruler upon the occupied station on the sheet, the telescope is then turned upon other objects which it is desirable to locate, and lines are drawn, in turn, toward them. The instrument is then taken up and moved to a second station, where it is again set up, leveled, and oriented, as before. A sight is then taken, and a line drawn in the direction of each point sighted from the first station, and the intersection of each pair of sight lines is the true position of the corresponding point upon the map. In this way, station after station is occupied by the plane table, and numerous points are located by intersection. If possible, each point thus located should be intersected from at least three stations in order to verify its location.

Any point thus located on the map may be used afterward as a station. In case it is necessary to occupy a point toward which no line has been drawn, or which has not been located, the simplest and best plan for effecting its location is as follows:

Fasten upon the plane-table board, which necessarily has not yet been oriented, a piece of tracing linen, or ,in default of that, a piece of tracing paper. Assume a point upon this linen to represent the station, take sights upon, and draw lines to all located points within the range of vision, and then, loosening the linen from the board, move it about over the map until these sight lines fall upon the proper points upon the map. Then prick through the position of the station from the linen to the map underneath. This location should then be tested by sighting from the point thus found to the various objects to see if the sight lines fall upon the points as marked upon the map.

In case one line of sight upon the required station has been obtained, that sight line may be utilized in making the location as follows by resection: Having leveled the table, place the alidade upon this sight line already drawn, with the telescope pointing toward the object from which the sight was taken. Then turn the table in azimuth until the telescope falls upon this point, and clamp it. The table is now oriented, but the position of the present station is unknown further than that it is known to be upon this line. Then select some station whose direction makes a wide angle with this line, and move the alidade until the cross wire falls upon this selected station, while the ruler at the same time is upon the representation of the station upon the map. The ruler will then cross the sight line at the point desired. By way of check, repeat the process with another station or located point. For this purpose a point in suitable direction is valuable in proportion to its proximity.

Using the instrument as described above, the topographer locates from them all possible points. Then visiting in turn such of them as he finds necessary, perhaps a dozen or twenty, he locates by intersection points all over the sheet in as great number and as well distributed as possible, and with special reference to the needs of the traverse men, who will come after him and whose work will be located by means of his determinations. All this work must be done with the utmost nicety and precision. The setting of the alidade upon the station must bisect the needle hole by which it is marked and the lines of direction must be drawn with a sharp-pointed pencil.

The necessity for precision will be recognized when it is understood that any error introduced in the early part of the plane-table triangulation will be not only perpetuated, but increased many times over as the work progresses, and as soon as an error becomes appreciable it produces difficulties and uncertainties in making locations, which may lead to embarrassing delays, and ultimately require that all the work be repeated.

MEASUREMENT OF ALTITUDES.

While making horizontal locations of points with the plane table, their heights must also be measured, relative to that of the point occupied. This is done by means of the vertical arc of the alidade and the level upon the telescope. Pointing upon the object whose relative height is to be measured, the telescope must first be brought to a horizontal position. In case the vertical arc is movable, its zero must then be brought to the zero of the vernier. In case it is not movable, the index error, with its sign, must be read. The telescope is then raised or depressed to the point and the reading obtained. This adjustment of the vertical arc or reading of the index error must be done for each point, as the table cannot be leveled with sufficient accuracy, or cannot be expected to maintain its level, so as to dispense with it. Knowing the horizontal distance to the point and the angle of elevation and depression, the difference in height is obtained by the solution of a right-angled triangle, thus:

$$h = d \text{ tang } a,$$

h being the difference in height, d the distance, and a the angle of elevation or depression. This distance is then to be corrected for curvature of the earth and for refraction by the atmosphere. The correction for the former is obtained with sufficient accuracy by the following empirical rule. The curvature in feet equals two-thirds the square of the distance in miles. It is always positive in sign, whatever may be the sign of the difference in height.

Refraction is an uncertain and variable quantity. It is usually greatest at morning and night and least at midday. It is greater the nearer the line of sight is to the ground. Often in desert regions it is excessive in amount. It is usually assumed at one-seventh the curvature, and is negative.

Tables for the solution of vertical angle work are appended to this volume. These give differences in height for all angles and distances which should be employed, with corrections for curvature and refraction.

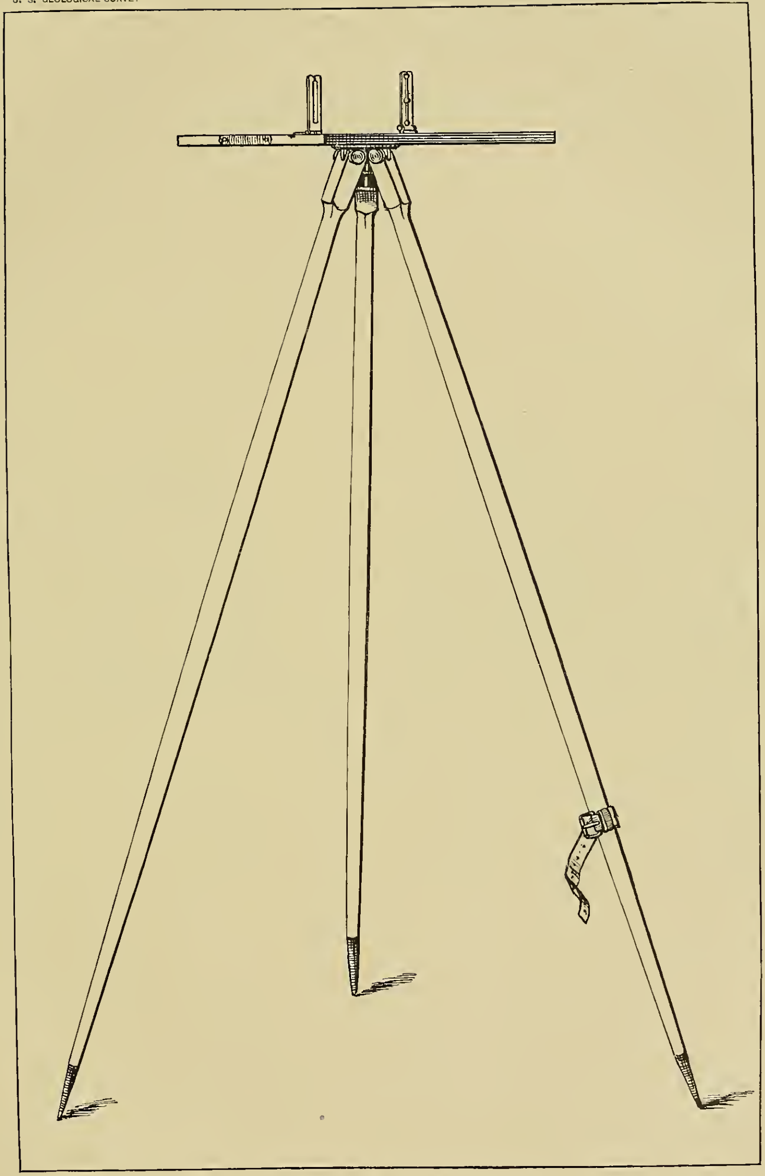
Differences of height should not be measured at greater distances than 10 miles, if it can be avoided. An error of 1′ in the measurement of the angle is at this distance about 15 feet, while the uncertainty of refraction in such a length of line is necessarily great.

TRAVERSE WORK.

As stated above, under the head of primary traverses, a traverse line consists of a series of direction and distance measurements depending upon one another. These lines should be connected wherever possible with triangulation points in order to check up accumulated errors. If it were practicable or economic to carry on all the work of location by intersection, this would be the most accurate and on most accounts the best way to effect it, but it is only in limited localities, such as high mountain regions, where bold topographic forms predominate and where there is little or no culture, that the method of intersection is practicable for locating all necessary points. It is probable that in nine-tenths of the area of the United States it will be found necessary to locate the details of topography, culture, and drainage by means of traverse lines. In different parts of the country the relative extent to which the two methods can be applied depends upon various circumstances, principally the amount of relief of the surface and the prevalence of forests. Thus upon the Atlantic Plain, which is densely covered with forest, and which is very level, it is necessary to use the traverse method exclusively, including even the primary control. Passing from this as an extreme case, through rolling and hilly country to the high sharp mountains of the West, the triangulation method becomes more and more prominent while the traverse method finally becomes used but little, except in the details of roads and other cultural features.

For executing traverse work various instruments have been in use for measuring both distances and directions. For direction there have been used theodolites of various forms and prismatic compasses and for distances the stadia and the wheel.

At present all traverse work is done with plane tables, upon which the directions and distances are platted directly. The plane table used for this purpose is of the simplest possible form, consisting of a board about 15 inches square, into one edge of which is set a narrow box containing a compass needle 3 inches in length. This table is supported by a tripod of light construction, without leveling apparatus, the leveling of the instrument being effected with sufficient accuracy by the tripod legs. A single screw fastens the board to the tripod head and the adjustment in azimuth is made by simply turning the board with the hand. It is held in place by friction. The table is adjusted in azimuth, or oriented, by means of the compass needle—that is, it is turned until the needle rests opposite the zero marks in the compass box, and is thus always made approximately parallel to itself, provided the magnetic declination remains constant.



TRAVERSE PLANE TABLE AND RULER ALIDADE.

The alidade consists of a brass ruler, 12 inches long, with folding sights. The edge of the ruler is graduated to facilitate platting of distances. Ordinary drawing paper backed with cloth is used for plane-table sheets, and is attached to the board by thumb tacks.

When traversing is done along roads, as is commonly the case, distances are measured by counting the revolutions of a wheel, usually one of the front wheels of a buggy or buckboard. For counting the revolutions, various automatic devices have been in use. The old form of odometer known as the pendulum was first tried and was unqualifiedly condemned. The form now in general use was devised by Mr. E. M. Douglas of this Survey. See Fig. 9.

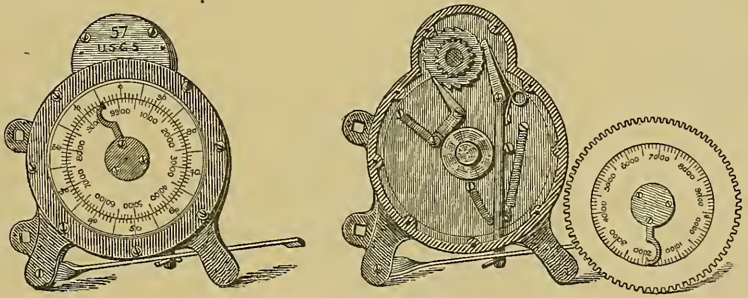


Fig. 9.—Douglas odometer.

For operating this a cam is placed on the hub of the wheel, which by raising a steel spring as the wheel revolves carries the index forward one division for each revolution. This form is the most trustworthy that has yet been devised, but is not altogether satisfactory, and many topographers prefer to count the revolutions of the wheel directly, using an arrangement by which a bell is rung at each revolution.

An experience covering many thousands of miles of measurement has shown that as a working method of measuring distances on roads the wheel is superior to the stadia, alike as to accuracy and rapidity

A traverse man is generally assigned a tract of country within which he is instructed to run traverses of all the public roads and of such of the private roads as appear to be necessary in order to control the entire tract. If practicable, he is furnished with the positions of the points located within his tract properly platted upon his plane-table sheet, or, if these can not be furnished, with such descriptions of them as are necessary to enable him to recognize them and close his lines upon them or connect with them by triangulation. He is furnished with a horse and buggy or buckboard, traverse plane table, and aneroid. He has no rodman, but is expected to sight natural objects. Setting up his instrument at his initial station, he levels it roughly by means of the tripod legs, orients it by turning the table until the compass needle is on the zero mark in the compass box, then, marking a point on the paper to represent his initial station, and placing his alidade upon it, he points it to an object selected as his second station, and draws a line in that direction. Driving along the road he passes the point sighted at, noting the distance to it by the reading of the odometer, or the count of the revolutions of the wheel, and the height as recorded by the aneroid, and passes on, selecting some point from which he can see the point sighted at. There he stops, sets up his table as before, orients it, and sights upon the same signal which he sighted from his initial station. He plots the distance to the signal along the sight line from his initial station; then from the location of the signal as thus established he plots his second station by the distance measurement and the reverse of the observed direction. In this way the work progresses, a hundred stations or more being occupied in the course of the day. In this work one should aim to make as few stations and to take as long sights as possible consistent with accuracy. Bends of the road between stations can be sketched with all needful accuracy.

During the progress of the work all points off the line which are capable of being located by intersection must be located by sights taken from stations, and special care must be taken to connect them with the points located by the secondary triangulation, in order to afford as many checks as possible to the accuracy of the traverse line.

Traverse lines should close with but trifling error—an eighth of an inch upon the paper in a distance of 10 or 12 miles is as great an error as should be permitted—and all errors of closure should be shown. No line should be arbitrarily closed on the traverse sheet.

The traverse man should sketch or locate all country houses, should note all road intersections and all railroad crossings, specifying by simple conventions the character of the crossing, whether over, under, or grade crossing. He should similarly describe all stream crossings, distinguishing fords, ferries, and bridges.

MEASUREMENTS OF HEIGHT IN CONNECTION WITH TRAVERSE LINES.

Height measurements in connection with traverse lines are effected in one of two ways—either by vertical angles with the telescopic alidade or by the use of the aneroid.

In regions where little or no secondary triangulation can be done, it becomes necessary to accompany certain of the traverse lines by profiles determined by vertical angles. Such profiles should be surveyed at intervals of 4 or 5 miles where the contour interval is 20 feet, and at intervals of 8 or 10 miles where it is 50 feet.

The alidade generally used in running these profiles is of a small compact form, with low standards and short ruler. The telescope has low power, but carries a good vertical arc and a level. The arc and vernier are graduated to single feet with a radius of a mile, instead of degrees and minutes, in order to facilitate computation. This graduation is made on the assumption that where the angle is less than 5° the arc and the tangent do not materially differ.

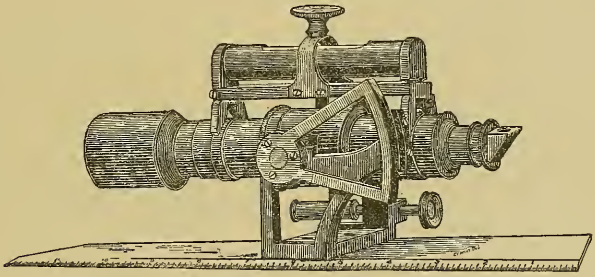


FIG. 10.—Small Telescopic Alidade.

With this instrument the plan of the traverse is run precisely as above sketched, except that a rodman is frequently employed. In running the profile, which is done coincidently with the plan, the points sighted for elevation may be the same as are used for the plan. If a rodman is employed, the target on the rod should be set at the height of the instrument to simplify record and computation.

It must not be understood, however, that it is at all necessary that the survey of the profile should establish the height of all the points located by the traverse. The profile should give the elevation of all valleys and summits, and of all road crossings. The line should be carried forward and these points measured by as few and as long lines of sight as possible. Often the roof of a house will furnish a datum point for use for a mile or two. Indeed, in an open, settled country the line can frequently be carried forward continuously by using housetops as targets.

The reduction of the profile must keep pace with the field work, so that on arriving at a check point the amount of the error may be shown at once. If this is not more than one-fourth or one-fifth of the contour interval, it is not considered as of material account. If, however, it reaches half a contour interval, the work should be examined, and if the error be not discovered the line should be resurveyed.

The heights, as determined, should be written in ink upon the plane-table sheet in their proper places.

THE ANEROID.

In the great majority of traverse work heights are measured with aneroids. The aneroid consists of a vacuum box of thin corrugated metal, which is compressed by an increase and expanded by a decrease in the pressure of the atmosphere. A train of mechanism magnifies this trifling movement enormously and moves an index upon a graduated dial. This dial is graduated to feet of elevation and also to inches of barometric pressure.

Several sizes of aneroids are made; that having a diameter of 2½ inches is on the whole found the most satisfactory.

Owing mainly to its extreme delicacy the aneroid is a very uncertain instrument. It should be used differentially only, and for small differences in height and small intervals of time. Its indications should be checked by reference to known elevations whenever opportunity is afforded during the day, and at the beginning and ending of each day's work.

On commencing work the movable scale on the aneroid should be set at the known height of the starting point and a note made of its reading on the inch scale. Elevations should then be read directly from the scale of feet. The heights of all points along the line of traverse which will be required in making the contour sketch should be read and written upon the traverse. Every depression and elevation, road crossing, etc., should thus be measured. There is, however, no necessity for reading the aneroid at every station in the traverse. It will merely encumber the work with a mass of useless data.

Upon reaching a check point, comparison should be made with the indications of the aneroid. If the difference is considerable—*i. e.*, more than a contour interval—the error should be distributed backward along the line in proportion to distance. If it is small, it may be neglected.

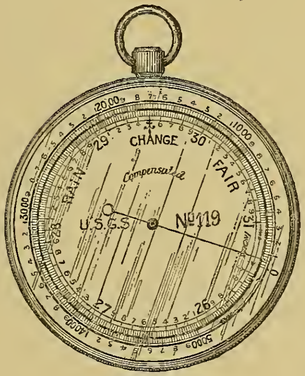


Fig. 11.—Aneroid.

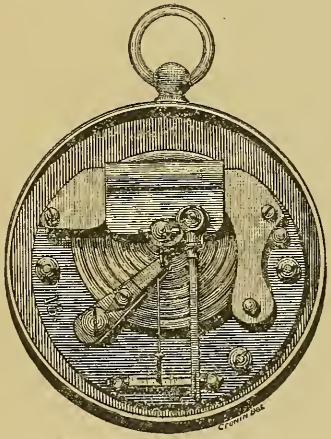


Fig. 12.—Works of the Aneroid.

In all this work notebooks are not required, except as a convenient form of carrying paper upon which to make the trifling computations required. The plane-table sheets comprise all the records necessary. The work, as it progresses, criticises itself by its closures in position and elevation, and, wherever necessary, is revised immediately.

ORGANIZATION OF PARTIES AND DISTRIBUTION OF WORK.

Secondary triangulation, traversing, measuring of heights, and sketching are commonly carried on by one party. This consists of the chief of party, who directs all the operations, and who does all the sketching; an assistant who carries on the secondary triangulation, selected as possessing special fitness for that work, and one, two, or more assistants who are engaged in traversing, the number of these assistants depending upon the rapidity with which the country can be sketched relative to the rate at which the traversing progresses. If possible, the different items of work of such a party should follow one another in a certain order. The secondary triangulation should be done first in order that the traverse men may be furnished with positions and heights for locating and checking their traverse lines. The traversing should follow, in order that all the control may be furnished to the chief of party for his use in sketching. This order, which is followed as closely as practicable, requires that the members of the party be scattered over a considerable area of country, and if they are living in camp it requires that they remain away from it a considerable part of the time, or else that a large amount of traveling be done in order to reach camp at night. Where they are not living in camp, the most economical disposition is to scatter them at various places within their fields of work. In any case, constant communication must be had between the chief of party and his assistants, in order that they may work in accord.

STADIA MEASUREMENT.

Under certain circumstances it is found advisable to use the stadia method for measuring distances in place of the wheel. This is the case where lines are to be run without reference to roads, and consequently where the wheel cannot be employed with advantage. It has been used, too, in southern Louisiana, where peculiar methods of work imposed by the nature of the topography have made its employment economic. The instrument used for the stadia or telemeter method of measuring distances may be anything carrying a telescope. To the reticule of the telescope are added two or more fixed horizontal wires placed at a certain distance apart. A rod or board subdivided to suit the interval between the wires and painted in glaring colors forms part of the outfit. When this rod is set up at a distance from the telescope, that distance is ascertained from the number of subdivisions of the rod which are included between the wires of the telescope, the value of each division of the rod being known. Upon the Geological Survey certain theodolites and telescopic alidades are equipped with stadia wires. These wires are three in number, the intervals between them being equal. The rods are 14 feet in length and hinged so as to close to 7 feet. The intervals upon the rods are of one foot each. The wires in the telescope are so spaced that when the rod is at a distance of 100 feet, the space between the two extreme wires will subtend one foot on the rod. At a distance of 1,400 feet, therefore, this space will subtend the entire length of the rod, while at a distance of 2,800 feet two adjacent wires in the telescope will subtend the entire length of the rod. Distances less than 100 feet are estimated by means of the fractional part of a foot upon the rod, which is included between the wires. The distances are read off upon the rod by the surveyor at the instrument.

In measuring distance upon slopes, correction must be made to reduce the inclination measured to horizontal distance. Tables for this reduction are to be found in Bulletin. Where the slope is slight it is not regarded as necessary to make this reduction, especially where there are frequent points for checking and correcting the line.

The rod may be used also for measurement of the profile of a line. For this purpose, a point should be marked upon it at the same height as the telescope of the instrument and vertical angles taken to this point.

The work which has been carried on in southern Louisiana is peculiar in the fact that the slopes are extremely gentle, requiring, in order to show the relief at all, a contour interval not greater than 5 feet. For the location of contours of so small an interval, even vertical angles are not sufficiently accurate, and the work of measurement is effected by spirit level. The instrument used is a theodolite of compact and simple form, to which the name of gradienter has been applied, which is equipped with stadia wires. The low ridges which accompany the streams of this region and which form all the relief are located by means of lines run approximately at right angles to the streams from their banks down to the swamps on either side. Distances are obtained by stadia and differences of elevation by using the gradienter as a wye level, and the stadia rod as a level-rod.

THE CISTERN BAROMETER.

In work having a large contour interval, 50 feet or more, the cistern barometer is used to some extent, though not as much as formerly. Its use is now confined to the work in the far West, where it is employed in the determinations of heights of points in the valleys not easily reached by vertical angles.

The barometer is an instrument for measuring the pressure of the atmosphere. At the level of the sea this pressure of about 15 pounds per square inch supports a column of mercury about 30 inches in height. As one rises above sea level and leaves a portion of the atmosphere behind him the pressure diminishes and the column of mercury sustained by it is of less height.

The cistern barometer, in its most portable form, is made by H. J. Green. It consists of a cistern into which dips the lower open end of a glass tube 31 or 32 inches in length, the whole being inclosed in a brass case. The cistern consists of a number of parts, including a short glass cylinder, below which is fitted the inverted frustum of a hollow cone of boxwood. This is succeeded by a second frustum, placed upright, from the lower end of which depends a bag of buckskin. The bottom of the latter is raised or lowered by means of a screw in the brass case of the cistern. The cistern is closed at the top by a boxwood ring, which is fitted to the top of the glass cylinder. By means of an annular piece of kid, which is securely lashed to the boxwood ring and to the barometer tube, the cistern and the tube are connected. From the under surface of the boxwood ring depends an ivory point about a quarter of an inch in length. Upon the brass casing of the tube is a graduation into inches and twentieths, by which, with the aid of verniers, the scale may be read to 0.002 of an inch. To this brass case is attached a thermometer, for indicating the temperature of the instrument. For carriage the barometer is placed in a wooden case fitted to its shape, and this in turn in a case of heavy leather fitted with a shoulder strap. It should always be carried in an inverted position.

To read the instrument it should be hung where it can swing freely. Then, by lowering the screw at the bottom, drop the mercury in the cistern until its top just touches the ivory point above mentioned. This can be best effected by making the ivory point and its reflection from the surface of the mercury barely touch one another. Then move the vernier until its bottom is just tangent to the convex top of the mercury in the tube.

The vernier is read like other verniers and requires no special explanation. Besides reading the height of the column of mercury in the barometer, it is necessary to read its temperature by means of the attached thermometer, and also the temperature of the air by means of a thermometer hung in the shade.

The barometer is used differentially—that is, the difference in height between two points is determined by the difference in the indications of two barometers, one at each point. In order to obtain the height above sea level of one of these points, that of the other must be known. The latter is called the base station, and its altitude should be determined either by leveling or by a long series of barometric observations referred to some other point whose altitude has been established. The proper selection of a base station or a system of base stations for reference of work to be done in a certain locality is a matter involving considerable judgment and a knowledge of the peculiar errors to which the barometer is liable, as well as a knowledge of the topography of the country and its probable influence upon the fluctuations of barometric pressure. The base station should be near the middle of the area. If but one base station is employed, it should be near the middle altitude of the region. If two be used, one should be at the altitude of the low or valley country and the other should in altitude be near the high summits. In the Hayden survey of Colorado three base stations were employed at once—one at Denver, at an altitude of 5,300 feet; one at Fairplay, 10,000 feet, and one near the summit of Mount Lincoln, 14,200 feet. To these base stations were referred severally those observations taken at points most nearly approaching them in height.

Comparisons should be made between the readings of the base barometer and the readings of those to be used in the field. These comparisons should be made with the barometers hung side by side and should be made in full—i. e., by lowering the mercury from the tubes, its level in the cistern to the ivory point, and resetting the verniers at each reading—and the attached thermometers should be read. Both barometers should be read by the same observer. A half dozen observations made at intervals of half an hour will answer as well as a greater number. Such comparisons should, if practicable, be made at the beginning and the end of the season, whenever a new tube is put into either barometer, or after any repairs to either instrument.

The discrepancies between the readings of two barometers are due to several causes, among which are differences in setting of the scale of inches, differences in the caliber of the tubes, causing different amounts of capillarity and differences in the perfection of the vacuums in the tubes. Differences due to the first two are generally trifling, amounting to but a few thousandths of an inch. If large discrepancies exist, they are usually due to the last cause, and this should be corrected.

The cistern barometer is a very frail instrument, and although in the mountain form it is protected from accident as thoroughly as possible, still tubes are not infrequently broken while in the field. It is necessary, therefore, to provide the requisite means for making repairs, such as sealed tubes, distilled mercury, etc. When a tube is broken, the barometer should be opened at once, and the mercury poured out, in order to prevent it from dissolving the screws and other brass work of the instrument.

The work of filling and replacing a tube is a delicate operation. After taking the barometer to pieces, the new tube should be opened by breaking off the small end, the break being made at a distance from the stricture equal to that upon the old tube. It should be effected by cutting it around with a sharp file, when a little pressure will cause it to break; then the edge of the break should be smoothed with a file. The collar which forms the top of the cistern should then be lashed on to the tube at the stricture. The mercury to be used should be very pure, and to clear it from mechanical impurities, it should be strained through chamois skin immediately before use. It should then be poured into the tube through a paper funnel, and the tube filled to within an inch of the top. Then, covering the open end of the tube with the finger, protected by a piece of kid, invert the tube, letting the bubble of air slowly traverse the tube up and down for the purpose of collecting the minute air bubbles which may have remained in the tube. Do this repeatedly, if necessary, until the mercury appears perfectly clear of bubbles. Then fill the tube with mercury, drawing out with a straw any bubbles that may then be near the top. Invert the tube in the case, put on the glass ring and the upper cone of the cistern, and screw them together. Then fill the cistern with mercury, put on the lower cone, with the bag and the brass cover, and the work is complete. The test of a satisfactory result is the sound made by the column of mercury as it strikes the top of the tube. If there is a sharp metallic click the vacuum is good, but if the sound is muffled the vacuum must be improved. It is well to warm the mercury before pouring it into the barometer, in order to drive out any moisture in it. This is especially advisable if the atmosphere is damp at the time.

It is by some thought advisable to boil the mercury in the tube during the operation of filling. This is usually done over an alcohol lamp, two or three inches of mercury being poured into the tube at a time and brought to a boil until the tube is filled. The mercury which is to be poured into the cistern is then also boiled. This is a very delicate and tedious operation, and is attended with much risk to the tubes. Its utility is questionable, inasmuch as the mercury in the barometer is exposed to the atmosphere and soon contains as much moisture as before.

It often becomes necessary to clean the surface of the mercury in the cistern. To do this, take off the lower cone of the cistern; then, placing the finger, protected by a piece of kid, over the open end of the tube, invert the barometer slowly and pour out the mercury from the cistern. Strain it through chamois skin, replace it in the cistern, and put the latter together again.

Observations at the base stations should, whenever practicable, be made hourly from 7 a. m. to 9 p. m., in order to insure having base observations coincident with those taken in the field. When not practicable to do this, they should be made at 7 a. m., 2, 6, and 9 p. m. Each observation should include the reading of the attached and detached thermometers. Whenever the observations at a station of the U. S. Weather Bureau are available, they may be used as base records. In most cases, however, these observations are made with barometers reading only to one-hundredth of an inch, but, upon proper application, the Weather Bureau has in all cases substituted barometers reading more minutely in order to meet the requirements of the work of this Survey.

In field work, barometers should be read at each camp hourly during the daytime, if practicable, or, if not, at such hours as to correspond with the readings at the base station and with readings made by the topographer in the course of his work, having in view the use of the camp as a sort of secondary base station. The topographer or his assistant should read the barometer on all stations, and at all important points the heights of which cannot be more easily obtained by vertical angles.

Measurements of height made with cistern barometers are subject to periodic and accidental errors. The periodic errors are probably due to imperfections in the formulas and constants used in the reduction. Many attempts both from theoretical and practical points of view have been made to remedy these defects, but thus far without success. The accidental errors are due to errors of observation and to local differences in the pressure of the air at the points at which observations are made. Where the horizontal distance between the two stations compared is great, such differences may be correspondingly great, and the same is true where there is a considerable difference of elevation between the two stations.

Under favorable circumstances barometric observations should give the height within a score of feet. Where the circumstances are unfavorable—as, for instance, where there is a great difference of elevation between the two stations or a great horizontal distance between them—the error may be large, reaching 100 feet, and even in extreme cases 200 feet.

REDUCTION OF BAROMETRIC OBSERVATIONS.

The pressure of the atmosphere at the sea level is approximately 15 pounds per square inch, or is equivalent to that of a column of mercury 30 inches in height. With elevation the pressure diminishes, but not in a simple ratio to the altitude, as would be the case if all the strata had the same density. The density is proportional to the pressure, and as the pressure upon each layer is produced by the body of air above it, it follows that each succeeding layer of air is less dense than that which underlies it. The relation between altitude and atmospheric pressure, as stated by Gilbert, is as follows:

> The difference in height of any two localities is equal to a certain constant distance multiplied by the difference between the logarithms of the air pressures at the two localities.

This relation gives the first and principal term in the various tables for the reduction of barometric work. Different determinations of the constant distance, known as the "pressure constant," have been made, and these different pressure constants cause the principal differences in the various tables in use.

Of the different sets of tables yielding good results, the most convenient for use are those known as Guyot's. They are published in the Smithsonian Miscellaneous Collections, No. 13, and republished in this volume tables I to V. These tables are derived from the formula of La Place and use his coefficients. The formula, reduced to English measures, is as follows:

$$Z = \log. \frac{h}{H} \times 60158.6 \text{ English feet} \left\{ \begin{array}{l} \left(1+\frac{t+t'-64}{900}\right) \\ (1+0.0026 \cos 2\,L) \\ \left(1+\frac{Z+52252}{20886860}+\frac{h}{10443430}\right) \end{array} \right.$$

$$\left.\begin{array}{ll} h & = \text{the observed height of the barometer} \\ \tau & = \text{the temperature of the barometer} \\ t & = \text{the temperature of the air} \end{array}\right\} \text{at the lower station;}$$

$$\left.\begin{array}{ll} h' & = \text{the observed height of the barometer} \\ \tau' & = \text{the temperature of the barometer} \\ t' & = \text{the temperature of the air} \end{array}\right\} \text{at the upper station.}$$

Z = the difference of level between the two barometers;

L = the mean latitude between the two stations;

H = the height of the barometer at the upper station reduced to the temperature of the barometer at the lower station; or,

$H = h' \{1 + 0.00008967\,(\tau - \tau')\}$.

Table I gives, in English feet, the value of log. H or $h \times 60158.6$ for every hundredth of an inch, from 12 to 31 inches in the barometer, together with the value of the additional thousandths, in a separate column. These values have been diminished by a constant, which does not alter the difference required.

Table II gives the correction 2.343 feet $\times (\tau - \tau')$ for the difference of the temperature of the barometers at the two stations, or $\tau - \tau'$. As the temperature at the upper station is generally lower, $\tau - \tau'$ is usually positive and the correction *negative*. It becomes *positive* when the temperature of the upper barometer is higher and $\tau - \tau'$ negative. When the heights of the barometers have been reduced to the same temperatures, or to the freezing point, this table will not be used.

Table IV shows the correction $D' \dfrac{z + 52252}{20886860}$ to be applied to the approximate altitude for the decrease of gravity on a vertical acting on the density of the mercurial column. It is always *additive*.

Table V furnishes the small correction $\dfrac{h}{10443430}$ for the decrease of gravity on a vertical acting on the density of the air; the height of the barometer h at the lower station representing its approximate altitude. Like the preceding correction, it is always *additive*.

USE OF THE TABLES.

In Table I find first the numbers corresponding to the observed heights of the barometer h and h'. Suppose, for instance, $h = 29.345$ in.; find in the first column on the left the number 29.3; on the same horizontal line, in the column headed .04, is given the number corresponding to $29.34 = 28121.7$; in the last column but one on the right, we find for $.005 = 4.5$, or for $29.345 = 28126.2$. Take likewise the value of h', and find the difference.

If the barometrical heights have not been previously reduced to the same temperature or to the freezing point, apply to the difference the correction found in Table II opposite the number representing $\tau - \tau'$; we thus obtain the approximate difference of level, D.

For computing the correction due to the expansion of the air according to its temperature, or $D \times \left(\dfrac{t + t' - 64}{900}\right)$ make the sum of the temperatures, subtract from that sum 64; multiply the rest into the approximate difference D and divide the product by 900. This correction is of the same sign as $(t+t'-64)$. By applying it, we obtain a second approximate difference of level, D′.

In Table III, with D′ and the mean latitude of the stations, find the correction for variation of gravity in latitude, and add it to D′, paying due attention to the sign.

In Table IV with D′, and in Table V with D′ and the height of the barometer at the lower station, take the corrections for the decrease of gravity on a vertical, and add them to the approximate difference of level.

The sum thus found is the true difference of level between the two stations, or Z; by adding the elevation of the lower station above the level of the sea, when known, we obtain the *altitude* of the upper station.

UTILIZATION OF THE WORK OF THE PUBLIC LAND SURVEYS.

In all the states and territories except the original thirteen, together with Vermont, Kentucky, Tennessee, Texas, and Alaska, the public-land surveys have been carried on, and many of these states have been entirely covered by these surveys.

These surveys were made for the purpose of dividing the land into parcels suitable for sale or other disposition, and with little reference to map purposes. The work differs widely in quality in different parts of the country, in some regions being very bad, in others of high quality. Generally speaking, the later work is much the better.

This work is extensively used by the Geological Survey as an aid in the preparation of its maps. The extent to which it is utilized, and the methods employed in using it, will be detailed in this chapter. Before proceeding with this, however, it is desirable to describe the methods by which this work has been and is carried on.

The system of subdivision is an extremely simple one. It consists, first, in the division of the land into large blocks, the division of these blocks into townships, approximately 6 miles on a side, and the subdivision of these townships into sections, each containing about 1 square mile. Further subdivision of these sections into quarter sections, or even smaller areas, has been done by private surveyors.

The supervision of the surveys is vested in surveyors-general, one in each state or territory in which such surveys are being carried on. The surveys are made by contract, at certain stated prices per linear mile, and are subject to examination by salaried officers of the Land Office.

The initial work consists in the measurement of a principal meridian and a base line, their intersection being the initial point of the survey. These lines are run with considerable care. The principal meridian may be run both northward and southward from the initial point, and the instructions require that observations be made for azimuth at intervals not greater than 12 miles, and that the line be double chained, two sets of chainmen being employed for that purpose. In measuring a base line, which is to follow as closely as possible a parallel of latitude, in case the theodolite be used it is to be run by means of a succession of tangents to the parallel, not exceeding 12 miles in length. At intervals of half a mile a point on the parallel is marked by offsets from the tangent line, and at the end of 12 miles a new tangent is commenced. In case it be run by solar compass, it must be checked by latitude observations at intervals of 12 miles. The base line may be run either east or west from the principal meridian. At intervals of 24 miles on the base line auxiliary meridians are run in the same manner as prescribed for the principal meridian, and, at intervals of 24 miles on the meridian, correction lines are run east and west in a similar manner. It is only recently that the interval between guide meridians and correction lines has been reduced to 24 miles, or 4 townships. Heretofore the intervals have differed at different times, but have in all cases been greater. These lines are run with a solar compass or theodolite, and never in later years with the ordinary compass, and all these lines double chained.

By this means the country is divided into approximate squares 24 miles on a side. Each such area is then divided into townships approximately 6 miles on a side. The east and west sides of these townships are meridians which are run northward from the base line or from the correction line, having a breadth upon the base or correction line of 6 miles, but decreasing in breadth with the convergence of the meridians. The north and south sides of the townships may be run east or west, as the case may be. The east and west township lines as at first run are simple random lines, which are corrected backward in order to suit the positions of the township corners, as determined upon the guide meridians and north and south township lines. The township lines are all run with a solar compass or transit, and double chaining is not required. The east and west sides of the sections are run in all cases northward, while the north and south sides may be run either east or west. As in running township lines, the first east and west and north and south lines in the northern tier of sections are merely random lines, to be corrected backward, the mile posts upon the township lines being regarded as the final locations of the section corners. In running the section lines the quarter-section corners are marked, but the lines are not run by the Government surveyors. The accumulated errors in the subdivision of the township are thrown into the northern and western tiers of sections.

Surveys have been started from numerous initial points, involving the measurement of a number of principal meridians and base lines. No system has been followed in the arrangement of principal meridians and base lines, or in the subdivision of the country with respect to them.

In making these surveys, topography is mapped to but a limited extent. The positions of all streams are obtained at the points of crossing of the lines—i. e., at intervals of a mile. The same is the case with roads. All streams of importance, however, are traversed, and, in the case of navigable streams, both banks are traversed separately. The margins of all lakes and ponds of magnitude are traversed, and the outlines of all swampy and marshy areas are indicated. Indeed, were the work done thoroughly everywhere, there would be obtained material for a map fairly accurate in details of the horizontal elements. Practically, however, the degree of fulness varies with the surveyor. In many cases the plats are sufficiently full of detail for maps upon a scale of 2 miles to an inch, and in some cases for a scale even larger. In other cases, over considerable areas, the drainage represented is exceedingly scanty. In some townships few or no streams are represented. In other words, for mapping purposes, the work is by no means uniform in quality. Furthermore, no attempt has heretofore been made to obtain correct positions. Most of the initial points of the survey were assumed arbitrarily, and their positions in latitude and longitude have never been determined. Another and, for mapping purposes, important element which is wanting in this work is the relief. In some cases aneroid observations have been taken along the lines of survey, but they were never used for the purpose of drawing contours.

The plats are prepared in duplicate, one copy being retained at the local land office and the other deposited in the central office at Washington. They are now being photolithographed, and a limited number printed of each. These plats are upon a scale of 2 inches to a mile They show the subdivisions of the townships with their areas. They show. also the streams, roads, swamps, lakes, timber, and prairie as they existed at the time of survey. Relief is but feebly expressed. If any attention is paid to it, it is indicated by crude hachures.

This work is of service mainly, if not entirely, in furnishing secondary locations. Its value for this purpose, however, differs widely. In some regions it is not sufficiently trustworthy to be used, even when closely controlled by triangulation. In forest-covered or broken country it is often difficult to find the corners, so that it becomes necessary to supplement the few discovered by traverses connecting one with another. This has been the case with the surveys in Missouri. In open country, on the other hand, where the surveys are of good quality, they furnish a complete and admirable system of minor location, often obviating entirely the necessity of making any horizontal locations, aside from the primary work necessary to eliminate the accumulated errors of the system. In Iowa, Illinois, and Wisconsin, traversing is done only to a limited extent and for the purpose of locating the details of what are called "diagonal" roads—that is, roads not upon section lines. The common practice of constructing roads upon section lines, which, in the prairie states, has grown out of this plan of subdivision, aids greatly in the work of survey. This system of roads is highly developed in Kansas, where, by state law, every section line may have a road upon it. This fact, coupled with the rectangular subdivision of the sections into quarters, 80's, and 40's, marked by fences or hedges, and the fact that all these subdivisions are indicated upon county maps, renders the work in this state a simple matter, while the resulting map is admirably controlled. The same is true of Nebraska and the Dakotas, as far as settlements have extended westward, while Wisconsin, Illinois, and Iowa present conditions almost as favorable.

The public-land surveys are corrected either by extending over them belts of triangulation or by primary traverses. When the former is employed, it is unnecessary to cover the area with triangulation. It is sufficient to restrict it to belts of simple figures, such as triangles or quadrilaterals, such belts being 75 to 100 miles apart.

Each triangulation station should be connected by the simplest and most direct method with the nearest section corner of the land surveys. This is done generally by measuring the direction and chaining the distance, although it may be necessary to run a short traverse, or even a bit of minor triangulation, in order to reach the section corner. In this way connection is made with the land surveys at intervals of 10 or 15 miles along the belt of the triangulation. These locations are of course supplemented by any other accurate locations which may have been made in the region under survey.

When primary traverses are employed for control, connection should be made with all section and township lines crossed, the distance along the line to the nearest corner should be measured, and the direction of the line relative to the courses of the traverse should be measured.

In open country, where the public-land surveys are of good quality, as above described, the work of the topographic parties is reduced to the measurement of heights, and sketching. All the roads are matters of public record and are obtained from the county officers. The same is true of the plats of all towns and the plans and profiles of all railroads. These are obtained and placed upon outline plats of the townships, upon a scale double that of which the maps are to be published.

Heights are measured with the vertical circle and by aneroid, except in Illinois, where, the contour interval being 10 feet, the vertical circle only is used.

Where both are used, the vertical angle lines are run at intervals of 4 or 5 miles in one direction, while roads at intervals of a mile are run in the other direction with aneroids, checking them upon the crossings of the vertical angle lines. Sketching goes on coincidently with the measurement of heights.

CHAPTER V.

SKETCHING.

This, being by far the most important part of the work of map making, should be done by the most competent man for this work in the party—as a rule, by its chief. Besides the fact that he is presumably the best sketcher in the party, there is another reason for requiring that he should execute the sketching. He is held responsible for the quality of the work, not only of the sketching, but also of the accuracy and the sufficiency of the control. In the sketching of the map he has the best possible opportunity for examining into the condition of the control and of remedying any weaknesses.

Upon the completion of the secondary triangulation, the traverse work, and the measurement of heights within an area, which may be large or small according to convenience—but preferably should comprise a quarter sheet—he should cause all this control to be assembled upon one sheet. The traverse lines with all points located from them should be adjusted to the secondary locations, and all measurements of height should be plotted upon this skeleton, thus presenting in complete form all the control within the area. With this sheet upon a sketching board the chief of party should go over the ground, sketching the drainage, culture, and forms of relief. The latter should be sketched in actual continuous contours, direct from the country as copy, so that upon leaving the sketching stations the only work remaining to complete the map will be inking and lettering. In heavy country, however, where the contours follow one another closely, it may often be sufficient to put in on the stations only a part of the contours—every fifth one, for instance—in order to economize time in the field. Stations for sketching may be selected with the utmost freedom. An exact location is unnecessary. Any point on or off the road which affords an outlook will serve. As a rule, frequent stations should be made, and one should not attempt to sketch at great distance unless the conditions are favorable, as they may be in a country of large, bold features. It may be necessary to travel over all the roads which have been traversed and to climb many hills in order to sketch the entire area satisfactorily. On the other hand, in a different region the entire area may be sketched by a limited amount of travel or from a few elevated points. In a low country of small features much travel will be required, as these details must be sketched from near points. In a bold country of high relief, which may be sketched entirely from a few points, care must be exercised in the selection of sketching stations. From a great altitude the lower details will be dwarfed and will measurably disappear, while from low points the relations, forms, and masses of the greater elevations cannot be properly seen. In such a country stations at different elevations must be selected in order to see all parts of the country to the best advantage. The extreme summits will prove of little service as sketching stations.

Sketching is artistic work. The power of seeing topographic forms in their proper shapes and proportions and of transferring these impressions to paper faithfully is of all acquirements one of the most difficult to obtain. The difficulty is increased by the necessity of expressing form by means of continuous contour lines at fixed intervals. This work involves a knowledge of the elements of structural geology and good judgment in applying them.

Every map, whatever its scale, is a reduction from nature and consequently must be more or less generalized. It is therefore impossible that any map can be an accurate, faithful picture of the country it represents. The smaller the scale the higher must be the degree of generalization, and the farther must the map necessarily depart from the original.

Now, it is in this matter of generalization that the judgment of the topographer is most severely tested. He must be able to take a broad as well as a detailed view of the country; he must understand the meaning of its broad features, and then must be able to interpret details in the light of those features. Thus, and thus only, will he be competent to make just generalizations. This will enable him to decide what details should be omitted and what ones preserved, and, where details are omitted, what to put in their places in order to bring out the dominant features.

It is not possible to define the degree of detail which the maps should represent. The limit commonly given—that is, the limit imposed by the scale of the map—is not always the best. In representing country which has little plan or system, such as moraines or sand dunes, it is well to work in as much detail as the scale will bear. But where the country shows a system in its structure to which the minor detail is subordinate, the omission of some of this detail may give greater prominence to the larger features. The amount of detail thus omitted must necessarily be left to the judgment of the topographer, but no more should be omitted than is necessary to give full expression to the general features of the country.

ORIGIN OF TOPOGRAPHIC FEATURES.

As an aid in the interpretation of the various topographic forms which present themselves, the following brief discussion is appended.

Topographic features originate from a variety of causes and are modified by many agencies. They are formed by uplift from beneath, of great or small extent. They are formed by deposition from volcanoes, glaciers, water, and the atmosphere. They are formed or modified by aqueous and ice erosion. They are modified by gravity.

These are the principal agencies in producing topographic forms as we see them to-day. These forms are only in rare cases the work of a single one of the above agencies; generally two or more have taken part in producing the present condition. Of all these, aqueous agencies are by far the most potent. Their work is seen in nearly all topographic forms, while in those of great age their action has been so extensive as to mask or obliterate all superficial traces of the action of any other agency.

UPLIFT.

The internal stresses of the earth, however produced, have resulted in raising certain portions of the crust and depressing others. Commonly these movements have been slow and of great duration. Some of them are of continental extent, producing plateaus, while others have been very limited in extent, throwing up narrow ridges or blocks. They have uplifted the strata at various angles, so high in some cases as to throw them beyond the vertical, infolding the strata and even breaking them by faults.

Incidental to the uplifts are flexures and faults. The flexures may be classed as anticlinal folds, where they are bent downward on either side, and monoclinal flexures, where local strata first bend downward and then by a reverse curve resume horizontality. In a fault the rock is divided by a fracture and one part is moved up past the other.

It is through uplift that continuous mountain ranges, ridges, and inclined plateaus have originated—not, however, in the shapes that appear to-day, for most of them during and since their rise have been carved by erosion out of all resemblance to the forms which uplift alone would have given them.

The ridges and valleys of the Appalachian region are the results of uplifts, with numerous sharp folds and faults, which raised at various angles an alternation of hard and soft beds, from which erosion has since carved the existing alternations of ridge and valley.

Other movements of uplift, resulting from the intrusion among the strata of great lenses of volcanic rock, have usually resulted in the formation of elliptic mountains or groups of mountains. As these movements have occurred at different periods in geologic history, some have been affected more, others less, by erosion. Certain mountains of this volcanic type present to-day an aspect little affected by erosion, while others have been greatly modified by its agency.

Sierra la Sal, in eastern Utah, is an example of this class. Here the stratified beds above the volcanic rock which were bent upward by the uplift were probably broken over the top, and have been removed by erosion until now they only surround the base of the group, dipping away from it steeply, forming hogbacks.

In New Mexico there are seen numerous volcanic "necks" rising abruptly from the plateau. These necks are intrusions of volcanic rocks, which were forced up while molten into the stratified rocks. The latter have since been eroded away, leaving the harder necks as isolated, precipitous mountains.

DEPOSITION FROM VOLCANIC ACTION.

Deposits from volcanic action may be grouped as follows: (1) of liquid lava, in the forms *a*, of streams and lakes, resulting in plains, tables, and mesas, and *b*, of cones with craters, with gentle slopes. (2) of scoriæ and cinders, of which have been built cones with steep slopes, either with round tops or with craters.

Deposits of the first group consist largely of fields of basalt which have been poured out from low vents or craters and spread in horizontal sheets, in many cases covering great extents of territory. The Snake river plains of Idaho furnish an example. As most of these eruptions are of recent date, these sheets of basalt have suffered little from erosion, their form remaining much the same as when they were poured out and spread over the land. The surface is undulating, broken here and there by low cliffs marking the edges of the flow, and by cracks and fissures here and there, especially near the borders of the field. Owing to the frequency of the fissures, flowing water is scarce upon these basalt fields, for the streams, sinking in the fissures, find underground channels, to reappear at the borders of the fields in springs.

AQUEOUS AGENCIES.

EROSION.

The principal agency in shaping topographic forms is aqueous erosion. In nine-tenths of the area of the United States the work of this agency is prominent, while over much the larger part of the country the forms are apparently due entirely to this action. It is so commonly seen, that the topographer finds himself unconsciously reasoning in accordance with its laws and attempting to apply them to forms produced by other agencies. A country shaped by aqueous erosion is to him a "regular" country, while one shaped by other agencies, less known, is irregular. The former can, to some extent, be foreseen. In such a region, one reasons from the seen to the unseen, while the vagaries of the latter can seldom be predicted. By its agency the Appalachian mountains have been reduced from a complicated system of mountain folds to the present comparatively low and simple system of sandstone ridges and limestone valleys. In the Cumberland plateau has been produced its remarkably complex drainage system. From enormous plateaus have been carved the great ranges of Colorado, with their peaks, canyons, and cliffs. From the plateaus of the Colorado drainage system thousands of feet of rock have been worn away, leaving here and there great cliffs and high plateaus to show the magnitude of its work, while the great canyons dividing the lower plateaus, some of them a mile in depth, though the least among its works, are the topographic wonders of the world. From the moment the land rose above the sea, this agency of destruction has been at work, and its labors will not cease until the land again sinks beneath the waves.

The action of water on rocks may be divided into three parts—weathering, transportation, and corrasion. The rocks of the general surface of the land, or the terrain, are disintegrated and converted into soil by weathering. The material thus loosened is transported by streams, and while thus being transported it helps to corrade other material from the channels of the streams. In weathering, the chief agents are solution by water, frost, the mechanical beating of rain, gravity, and vegetation. Some rocks, particularly limestones, are entirely dissolved by water, especially when it is charged with carbonic acid; others are dissolved only in part and the remaining part is thus disintegrated. Rocks are cracked and broken by the freezing of water in their interstices. When the foot of a cliff is undermined by erosion, the upper portion, failing of support, breaks off in fragments by its own weight. The roots of plants pushing their way into the interstices of rocks pry them apart and thus aid in disintegration. In general, soft rocks disintegrate more rapidly than hard rocks and soluble rocks more rapidly than insoluble rocks. Disintegration is more rapid in a moist than in a dry climate.

The product of disintegration is soil, and this may be regarded in future discussion as a soft bed subject to the same laws of corrasion and transportation as other beds, with only such modifications as its want of cohesion requires.

TRANSPORTATION AND CORRASION.

Rain falls upon the surface, a portion of it sinks and reappears in springs, while another portion flows down the surface and collects in water courses, which, joining one another, produce, finally, large streams. During a rain storm the entire surface is a network of water courses, from the most minute rills to the main streams, and in studying transportation and corrasion the action of these minute rills, which cover the entire terrain, must be considered as fully as that of the main stream and its primary branches.

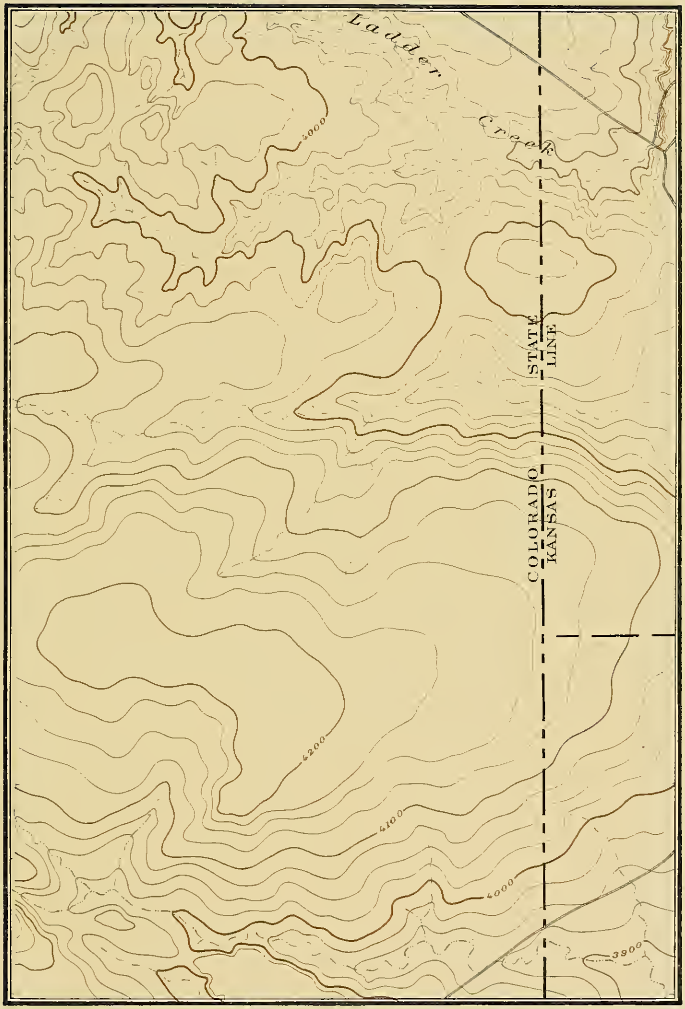
Corrasion is effected by the detritus which running water holds in suspension. Soft rocks are corraded rapidly, hard rocks slowly. The rate of corrasion is increased by an increase in the volume of the stream, an increase in its velocity, an increase in the amount of detritus borne by it, and by increased coarseness of that detritus. Hence it is that the tiny rain-water rivulets have very feeble corrasive powers; but as they combine into larger and larger streams, and as they wash into their channels a larger and larger amount of detritus, and as the slope of their beds becomes greater, their power for corrading their beds increases, and hence it is that the corrading power of the main stream is greater than that of any of its branches, and in the main stream, if the slope were uniform, the corrasive power would be greatest near its mouth.

Suppose a stream to have initially a uniform slope from its source to its mouth—then its volume, its velocity, and the amount of detritus borne by it will be greatest near its mouth; and corrasion, although going on all along its course, will be most rapid there. The slope of the stream will therefore be reduced most rapidly in the lower part of its course, and thence progressively up stream. It results from this that the normal profile of a stream bed is a curve, concave upward.

While the slope of the stream bed remains considerable and the velocity consequently great, the stream flows in a comparatively straight channel, and devotes its energies to deepening its bed, and thus reducing its slope. As the slope becomes thus reduced the course of the stream changes to a crooked, winding one, and its corrasive energies are diverted from its bottom to the sides of its bed. It is then said to approach "base level."

Swift streams commonly flow in straight channels; sluggish streams, in crooked channels.

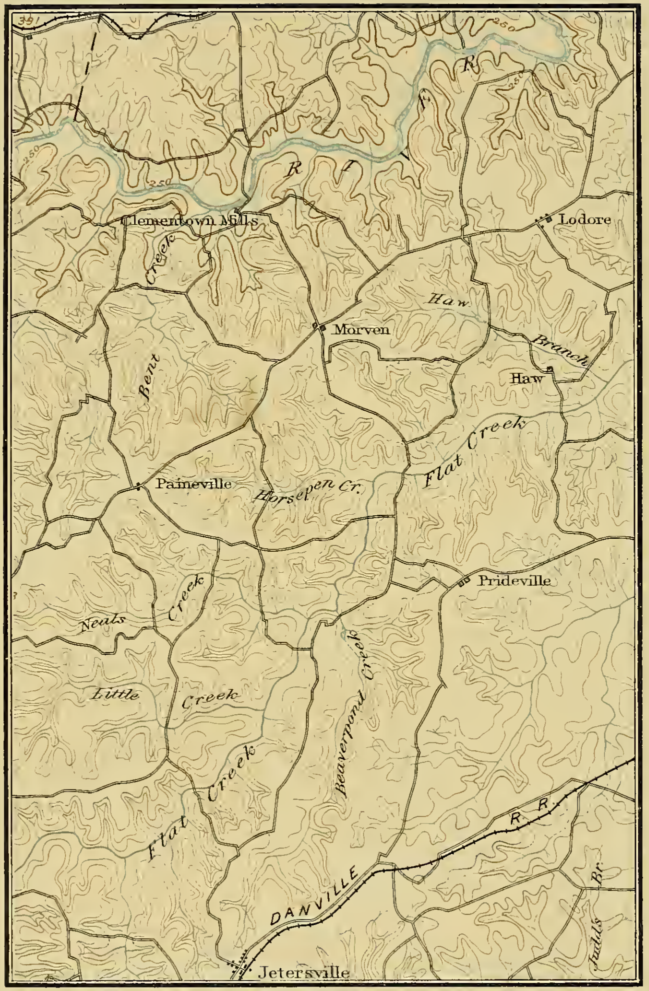
While lowering its bed by corrasion the main stream lowers, necessarily, the mouths of its immediate affluents, and these affluents are, therefore, in addition to their own proper work, obliged to cut their lower courses down


Ladder Creek
STATE LINE
COLORADO
KANSAS
4000
4200
4100
4000
3900

A BIT OF THE GREAT PLAINS, COLO., AND KAN., NEAR BASE LEVEL.

Scale $\frac{1}{125,000}$

Contour Interval 25 feet


391
250
250
250
250
R
R
I
V
Clementown Mills
Creek
Lodore
Haw
Branch
Morven
Haw
Bent
Flat Creek
Paineville
Horsepen Cr.
Prideville
Neals
Creek
Little
Creek
Flat Creek
Beaverpond Creek
DANVILLE
R. R.
Judds
Br.
Jetersville

A BIT OF THE ATLANTIC PLAIN, VA. NEAR BASE LEVEL.

Scale $\frac{1}{125,000}$

Contour Interval 50 feet

to a level with the main stream. The same operation which is going on in the main stream is going on in these affluents, but with different intensity, owing to their smaller volume of water and perhaps smaller amount of sediment, and to the fact noted below, that their mouths are constantly being lowered. Now, following up these branches as they subdivide into smaller and smaller streams, a point is finally reached where the little rivulets, with their feeble cutting power, are only able to keep their lower courses cut down to the level of the stream to which they are tributary. They have no energy to spare in working back up their own courses. At this point the curve changes from one concave upward to one convex upward. This convex curve is the curve of all the minor rain-water rivulets—in short, it is the curve of the terrain—while the concave curve is the curve of the water courses. The former is the curve of the upper relief of the country, the latter is the curve of the valleys.

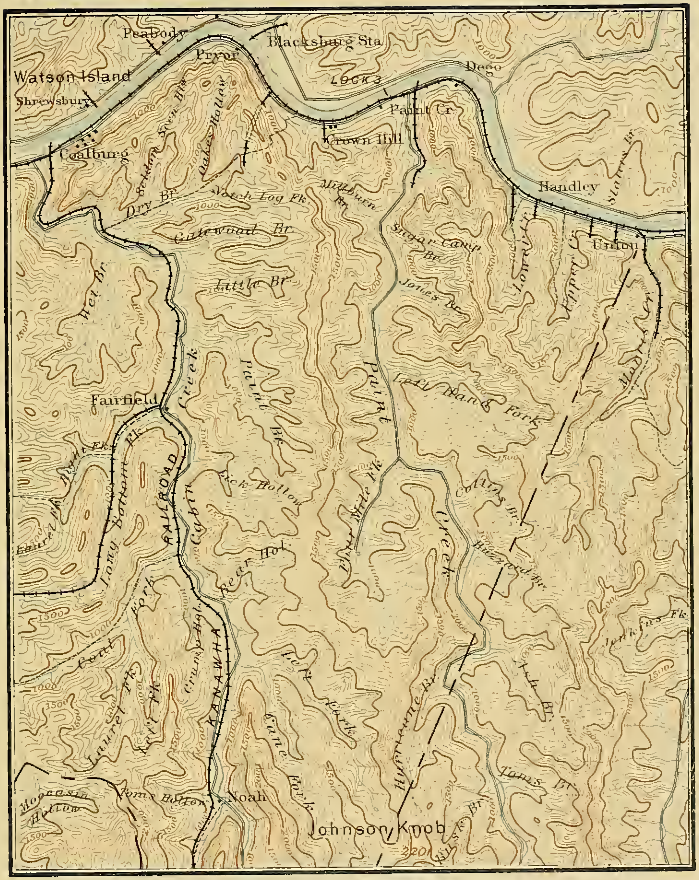
The relative extent of these two curves depends mainly upon the climate and upon the range of elevation of the country, or, in other words, upon the relative rapidity of corrasion of their beds by the perennial streams, and the erosion of the terrain by the rain-water rivulets. In a well-watered region, where the range of elevation is small, and where the larger streams are near base level, the hill forms are broad, rounded, and convex, and the valleys are equally rounded, with concave forms. Of this type is the undulating billowy surface of the Great Plains and the Atlantic and Gulf plains of the Southern states.

Where the range of elevation is great, the curves both of valley and ridge become sharper and more angular. The streams have a greater fall and proportionally increased power, and therefore cut more rapidly; but, on the other hand, they have more work to perform. The Cumberland plateau, with its intricate network of streams, consists of a close alternation of ridges and valleys, with straight slopes at very steep angles, the bottoms of the gorges and the summits of the ridges being but slightly rounded. Few of the streams have reached base level, except in some cases near their mouths, and corrasion of their beds is still active. In a high mountain range all these features become still more accented. The main streams have a steep descent and corrade their beds rapidly. Their valleys are narrow, with steep slopes on both sides. The mouths of the secondary streams are rapidly lowered, and thereby their work is greatly increased.

There is therefore a distinction to be observed between superficial erosion or erosion by the petty rain-water streams on the one hand and that by the larger streams on the other. The first forms, as a rule, convex slopes; the last, concave slopes. Between them, however, no sharp line can be drawn. In general, the former erodes soil only, the soft superficial bed, while the latter, if swift, is at work chiefly on rock. The energy of the former is widely dispersed, that of the latter is concentrated. The general reduction of the surface is done by the former, while the latter is confined to deepening narrow stream beds. Where the main streams are near base level, superficial erosion goes on more rapidly than stream corrasion, since the slope and velocity of the streams are near a minimum. Where the streams are still corrading rapidly, their beds are usually lowered faster than the terrain, and the balance is more and more on the side of the streams, the greater the range of elevation. In a mountain region, as has just been stated, the gorges are cut far below the spurs and summits. Hence, where stream corrasion predominates over surface erosion, the concave curve predominates, and where surface erosion is more rapid than corrasion by the streams, the convex curve is the ruling one.

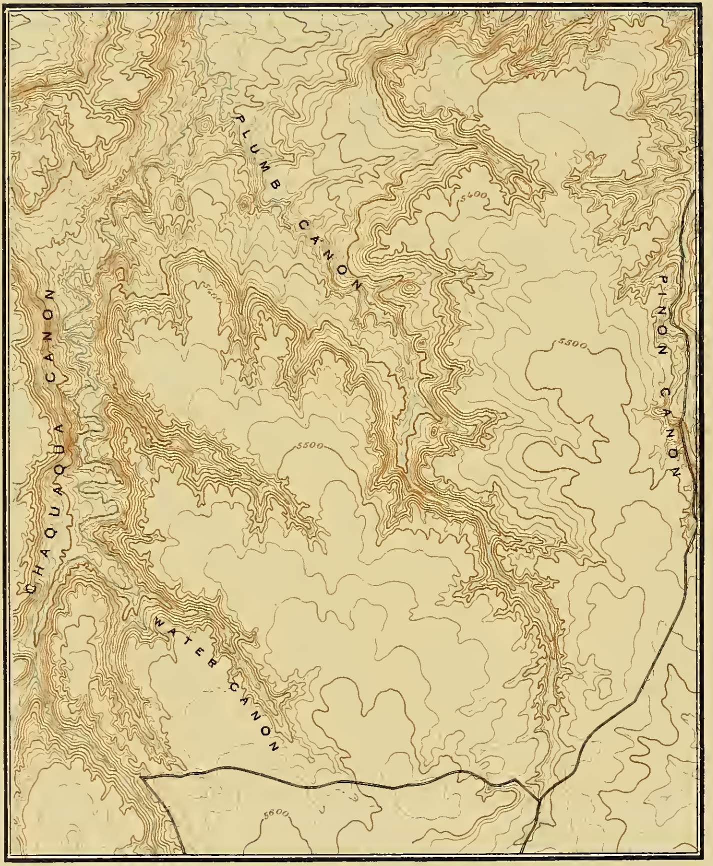
In an arid region, where the rain-fall is not only scanty, but spasmodic in character, coming mainly in sudden showers of great volume, but short duration, the stream beds are few in number. The drainage system is scanty and imperfectly developed. The weathering of rocks goes on slowly, and consequently the soil bed is thin. The soft material which the streamlets can erode is not abundant. Consequently the scanty rains do little surface erosion, but as they collect in large volume in the few water courses, they deepen them at a rapid rate. Erosion of the terrain in an arid region is therefore slow, while stream corrasion is proportionally rapid.

It is frequently the case that streams collect their waters from high mountains, and on their way to the sea pass down through arid regions. The action of such streams upon the arid region is the same as above described from streams originating within this region, except that it is more intense. Little or none of the waters of such a stream flows over the ter-


Peabody
Pryor
Blacksburg Sta
Watson Island
Shrewsbury
LOCK 3
Dego
Paint Cr.
Crown Hill
Coalburg
Handley
Union
Dry Br.
Notch Log Fk.
Millburn Br.
Gatewood Br.
Sugar Camp Br.
Little Br.
Jones Br.
Wet Br.
Creek
Paint
Left Hand Fork
Fairfield
Long Bottom Br.
RAILROAD
Cabin
Collins Br.
Buzzard Br.
Bear Hol.
Lick Hollow
Coal
Fork
Laurel Fk.
KANAWHA
Creek
Jenkins Fk.
Hurricane Br.
Toms Br.
Moccasin Hollow
Toms Hollow
Noah
Johnson Knob
2201
1000
1500

A PORTION OF THE CUMBERLAND PLATEAU, IN W. VA.

Scale $\frac{1}{125,000}$
Contour Interval 100 feet


PLUMB CAÑON
PIÑON CAÑON
CHAQUAQUA CAÑON
WATER CAÑON
5400
5500
5500
5500
5600

CANYONS IN HOMOGENEOUS ROCKS.

Scale $\frac{1}{125,000}$

Contour Interval 25 feet

rain of the arid area, to contribute to the planing down of its surface; but, on the other hand, the volume and consequently the energies of the stream for corrasion are greatly increased by the copious contributions from the mountain region. Therefore, in such cases corrasion by the streams reaches a maximum, relative to erosion of the terrain.

It is thus that canyons in the arid region are formed. They are found wherever, from any cause, stream corrasion is decidedly more rapid than surface erosion.

Such canyons, when in homogeneous rocks, rarely contain vertical cliffs. These are commonly formed in strata of differing hardness by sapping and undermining, which will be explained later.

In certain parts of the arid region, notably in the Great basin, the rainfall is so scanty that the drainage systems are very feeble. The little rain that falls in the valleys is at once absorbed by the thirsty soil or the atmosphere, while the streams which flow down from the mountains, cutting, it may be, deep canyons in their sides, dwindle away on reaching the valley, depositing, as they sink, their loads of detritus. With this detritus have been floored to a vast depth most of the valleys of the Great basin. It has been deposited there, instead of being carried off to the sea. The Great basin, which is in reality a large number of basins more or less independent of one another, is without outlet simply because of its small rainfall. Were the rainfall to increase, it would soon contain many lakes, and as the water rose these would overflow, the higher flowing into the lower and the lower flowing into the sea. The streams connecting them and the sea, would soon corrade channels, cutting them down to lower and still lower levels, and progressively draining these lakes, and thus a drainage system would be established.

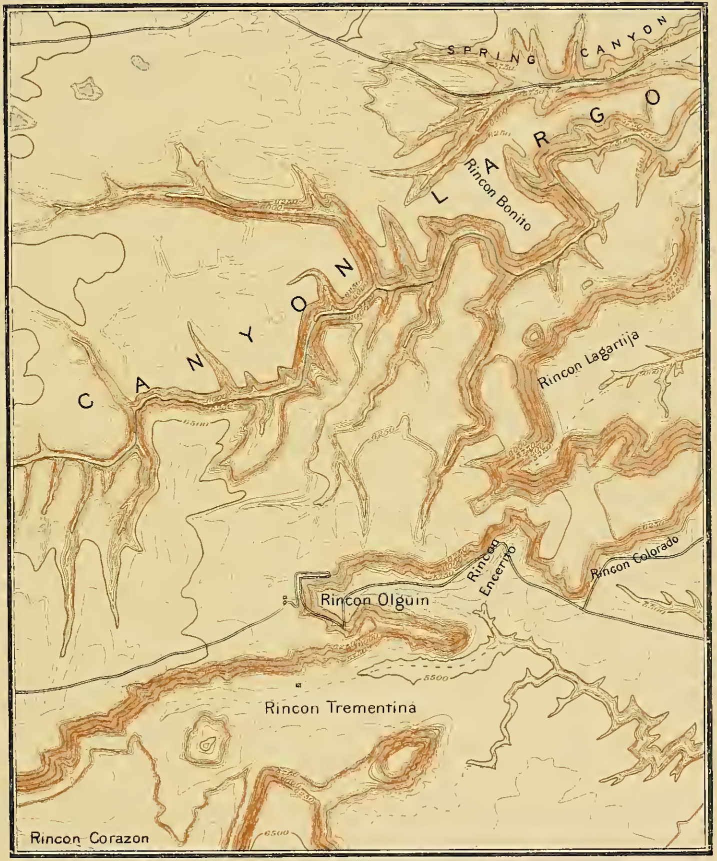
Sinks exist in other parts of the country, but are there due to different causes. They are common in the Appalachian region. In these sinks the water has an underground outlet through passages in the soluble limestone with which the valleys are floored. They are common among the terminal moraines of the continental glacier, in Minnesota, Wisconsin, Michigan, and New England, where they are called kettles. Here glacial material has been deposited so recently that time has not yet been afforded for the establishment of drainage systems.

Every stream tends to extend its drainage area by erosion at its sources on all sides, necessarily at the expense of its neighbors. The stream having the most rapid fall erodes the margin of its basin most rapidly. Hence in their struggle for existence the stream having the most rapid descent succeeds in drawing area from others. But in so doing it diminishes its own rate of fall, so that eventually a state of equilibrium among streams may be reached. This extension of basins is called piracy. It is going on actively in the Appalachian valley, where numerous examples may be found.

While under certain circumstances the courses of streams are mutable, under other conditions streams maintain their courses with great pertinacity. Of this, water gaps and canyons across mountain ranges are striking results. Where such a canyon is found, the river flowed before the range or ridge existed. The range may have risen across its course, in which case the river, like a circular saw, maintained its course by corrasion, cutting the canyon as the mountain rose. Of this action the canyon of Green river through the Uinta range is an example.

Or, the river, draining a surface of soft or soluble rocks, and eroding this surface down, may have uncovered a ridge of hard rock lying across its course. In this case, like the other, the river maintains its course by cutting a canyon through the ridge. The Appalachian valley presents numberless examples of water gaps formed as above described. Among them may be mentioned Delaware Water gap, through which Delaware river passes Kittatinny mountain, gaps of the Susquehanna and the Juniata, that of the Potomac at Harpers Ferry, and Big Moccasin gap, while Little Moccasin gap is in process of completion. While these are prominent and well known cases, in certain localities, every little ridge is cut into a line of knobs by them, so that, next to the parallelism of its ridges and valleys, the water gaps of the Appalachian valley constitute its most prominent feature. Such of these gaps as can be shown should appear on the map, and when owing to the minuteness of these features it becomes necessary to omit them, one should recognize the fact that the formation in this region is that of parallel ridges and so represent the structure.

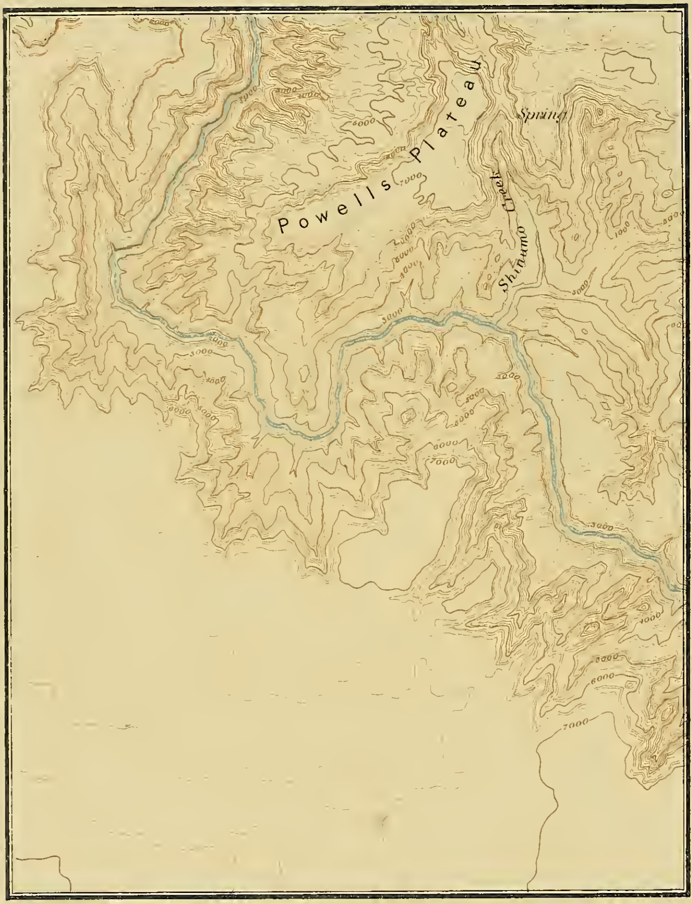
Wind gaps are abandoned water gaps, from which the stream has been drawn away by a more powerful neighbor. These should not be


SPRING CANYON
CANYON LARGO
Rincon Bonito
Rincon Lagartija
Rincon Colorado
Rincon Encerrito
Rincon Olguin
Rincon Trementina
Rincon Corazon
6500
5500

CANYONS AND CLIFFS IN ROCKS NOT HOMOGENOUS, N. M.

Scale $\frac{1}{125,000}$

Contour Interval 50 feet


Powells Plateau
Spring
Shinumo Creek
3000
4000
5000
6000
7000

A PORTION OF THE GRAND CANYON OF COLORADO RIVER, ARIZ.

Scale $\frac{1}{250,000}$

Contour Interval 250 feet

confounded with passes, or low points in mountain ranges, caused by the eating away of divides at the heads of streams.

The valley of every stream above base level slopes not only toward the stream, but with it—i. e., toward its mouth. Every branch on entering the valley feels the influence of this slope and turns its course in greater or less degree down the valley, entering the main stream at an acute angle. Similarly the main stream feels the influence of the tributary and turns toward it; hence the tributary commonly joins the main stream at the head of a bend in the latter.

When, however, a stream has recently, by the extension of its drainage basin, tapped an adjacent stream, the stream so tapped may not yet have accommodated its course to that of the principal stream, so that it still enters it at an obtuse angle.

Again, when the stream is near base level a different condition is presented. The main stream is on a ridge of its own construction, and the tributary often comes into the valley at a lower level than the ridge and flows parallel with it for a distance before breaking through and joining its waters. Loup fork of the Platte river, Nebraska, is an example of this. The Platte flows there upon a ridge of its own creation. The Loup comes down into its valley and flows parallel to it for many miles.

As was stated before, a stream near base level becomes crooked and winding. It has ceased to corrade its bottom, but corrades the sides of its bed, especially at the heads of its bends, and deposits its load on the inside of its bends. Its course changes frequently, now extending its bends farther into the bank and now cutting them off. In this way it eventually excavates a broad alluvial bottom, which may be subject to overflow when the stream is in flood and through which the stream winds in long curves, of size roughly proportional to the magnitude of the stream.

In the preceding pages no reference has been made to the influence of structure upon topographic forms. The alternation of hard and soft beds of rock and the dip of these beds have decided influence upon topographic forms, which are now to be considered. The influence of these factors upon topography is, it must be premised, greater in the arid regions of the West than in the moister East. The reason of this is that disintegration is much more rapid in the moister climate, and consequently that, finding an abundance of material in the bed of soil, a larger proportion of the energies of corrasion are devoted to removing it, while proportionately less is devoted to rock work. Still the effect of structure is by no means absent in the East.

Since disintegration and corrasion of hard or insoluble rocks go on slowly, and of soft or soluble rocks rapidly, the elevated areas are consequently, as a rule, composed of the former, while the depressed areas are commonly of the latter class of rocks. *It is the survival of the hardest.*

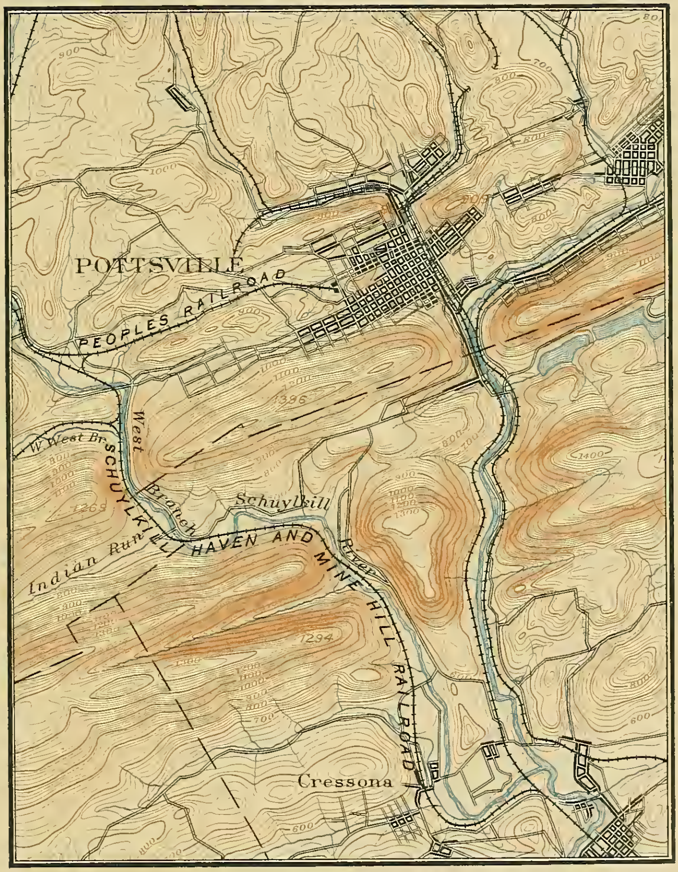
When erosion has left a peak, a projection, spur or boss, a butte or mesa, a neck or dike, it is commonly because the material is harder than that adjoining. The valleys of the Appalachian region are almost without exception cut in soluble limestone, while the ridges are mainly, and the higher ones entirely, of sandstone.

Streams usually make their channels along lines of least resistance. They accommodate themselves to the softness of the rocks and avoid obstacles. The more rapid the stream, however, the less does it care for obstacles, while gentle streams are most easily diverted.

The level surface of a plateau is generally the summit of a hard bed, from which, it may be, softer beds have been washed away and on which erosion has comparatively come to a standstill.

Where rocks of different hardness are subjected for the same time to an equal intensity of corrasion, since the effect upon the softer rock is greater than that upon the harder, it will be brought down to gentler slopes; in other words, other things being equal, the harder the rock the steeper the slope, the softer the rock the more gentle the slope. Now, let this proposition be applied to the cross sections of stream beds. Suppose two stream beds, one in soft rock, another in hard rock, both of them subjected to the same climatic agencies and the same corrasive action for the same time. In these two rocks the stream beds will be carved somewhat as shown in Nos. 1 and 2, in Figure 13, indicating progressive stages of operation.

The simplest case for consideration and a very common one is that of horizontal beds, alternately hard and soft, such as are represented in Fig-


POTTSVILLE
PEOPLES RAILROAD
SCHUYLKILL HAVEN AND MINE HILL RAILROAD
W. West Br.
West Branch
Schuylkill River
Indian Run
Cressona
1386
1269
1294
1400

WATERGAPS, PA.

Scale $\frac{1}{62,500}$

Contour Interval 20 feet

ure 13, Nos. 3 and 4. Suppose No. 3 to represent a cross section of a canyon, the upper bed of the plateau being hard, succeeded by soft and hard beds in alternation, as is seen in the Grand canyon of the Colorado, Pl. XIII. The course of the stream in forming this canyon is shown by the light lines in the figure. It cuts first a canyon with steep sides in the upper hard bed, an operation which perhaps consumes much time. Then reaching the softer bed below, it burrows rapidly into it, at the same time undermining the bed above, which from its weight breaks away, leaving cliffs. A similar operation carries it through the next hard and soft beds. Thus a succession of cliffs and terraces is formed. The presence of cliffs in a canyon wall generally indicates that the bed beneath the cliff is more easily eroded than that above it. The fragments of the cliff falling upon the slope of the soft bed below form what is known as a talus.

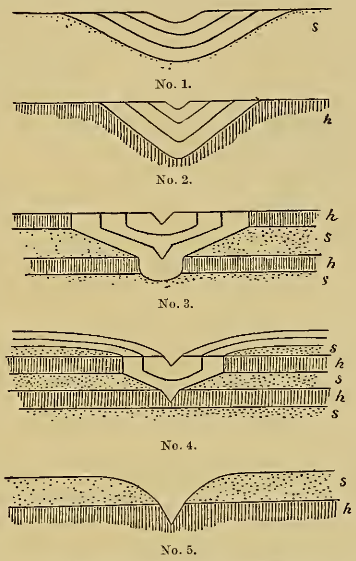
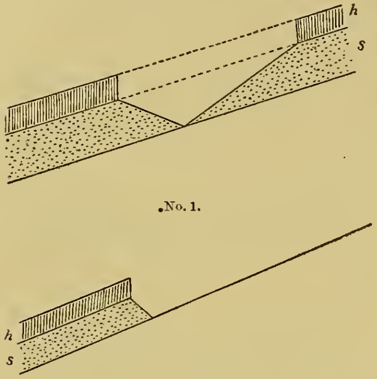


FIG. 13—Cross sections of canyons.

The above is a common case in a plateau region, since the surface bed is usually hard. Where the surface consists of a soft bed, No. 4, Fig. 13, represents the condition of the canyon walls. The undulating surface of the soft bed slopes down to the cliff produced by undermining the hard bed beneath. Otherwise the case is similar to that described above.

A third case is afforded by the Black canyon of the Gunnison in Colorado, where a hard sandstone forms the surface of the plateau, underlain by granite. A section is represented by No. 5 in Fig. 13. The sandstone stands at an angle of about 30°, beneath which are the walls of the granite canyon, which are somewhat steeper, the angle of slope being perhaps 40° to 45°. There is no undermining and consequently there are no vertical cliffs.

Consider next the case of a stream flowing parallel to the strike of inclined beds, where they are alternately hard and soft. When the inclination of the beds is not great, the stream, having cut down to the surface of the hard bed, as represented in No. 1, Fig. 14, tends to travel laterally down the dip of the bed, undermining both soft and hard beds on the lower side and extending the slope on the upper side. When the dip is considerable, it may carry away all the material on the upper side, as in No. 2, Fig. 14.



No. 1.

No. 2.

FIG. 14.—Cross sections in inclined beds.

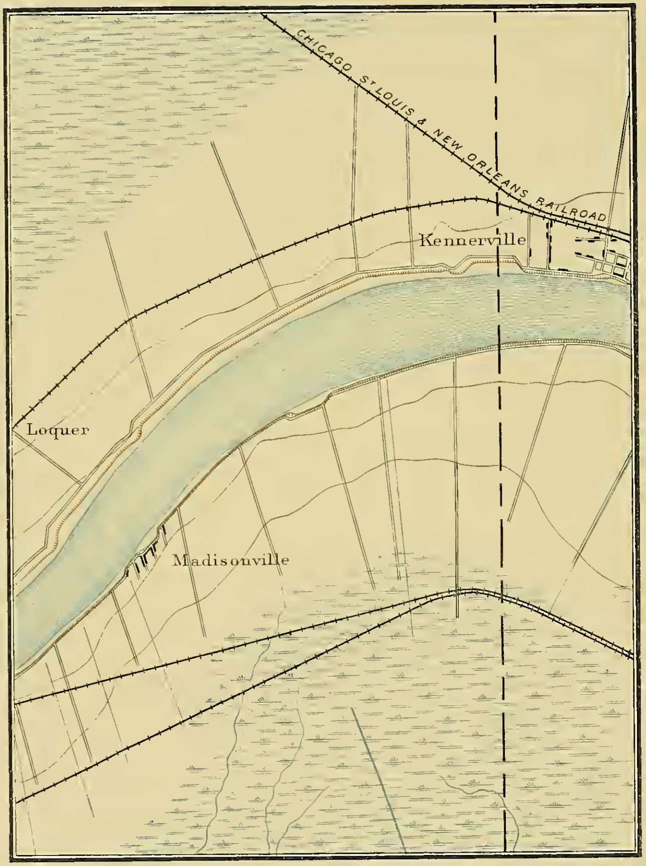
In this way streams may cut broad swaths across the terrain and remove both hard and soft beds from great areas of inclined plateaus.

Fine examples of streams flowing on the strike of hard inclined strata are seen in the hogbacks of Colorado.

Next, consider the longitudinal profile of a stream which is cutting its bed, when flowing over a succession of beds alternately hard and soft. Since it cuts soft rocks more rapidly than hard ones, its profile will show irregularities. Where flowing over soft beds, its current is less rapid than over hard beds of rock. The stream adjusts its profile to the work to be performed.

The ultimate result of aqueous erosion upon a surface is to reduce it to a plain of slight elevation, of gentle, easy slopes. It then approaches base level, a condition where the entire surface resembles the condition of a base-level stream, where vertical corrasion is practically at an end. Absolute base level is a conception merely, which many regions approach, but, owing to the fact that as the slopes become gentler, erosion becomes feebler, they cannot reach.

The stage of progress of an area toward base level is said to indicate its age. In youth it may present a great elevation and high relief. Its streams may have rapid courses with irregular profiles, broken by lakes,


CHICAGO ST LOUIS & NEW ORLEANS RAILROAD
Kennerville
Loquer
Madisonville

THE RIDGE OF MISSISSIPPI RIVER, LA.

Scale $\frac{1}{62,500}$
Contour Interval 5 feet

rapids, and falls. As the age of the region increases these inequalities are cut away. The lakes are drained, the falls and rapids disappear. The mountains and hills are worn down, and finally the entire surface is reduced to a low rolling expanse. The region approaches base level. It is in its old age. Plains represent old age among topographic features.

The life of a topographic area is not to be measured in years, but in its cycle of changes, which have little reference to time. The time required to run through its life differs with the conditions under which and the materials upon which erosion acts. It varies with the intensity of erosive action and with the amount of work to be done.

Sometimes a region after being reduced nearly to base level has been again elevated. Such elevation brings again into action the erosive agencies to carve and plane the terrain a second time. A region thus restored to youth by elevation is the mountain region of North Carolina. The bench level of the country is an old base level, which has been raised. In this the streams are now cutting and regulating their courses, while the bench level, in its gentle undulations, shows the old base-level surface, little affected as yet by recent erosion.

DEPOSITION FROM WATER.

When the swift current of a stream is checked, as by a reduction of slope or by a widening of its bed, it deposits a part of its load. It is thus that river banks, river and lake terraces, and bars at the mouth of streams are made. Of the building of river banks, fine examples are seen in southern Louisiana. Before the stream was lined with levees the Mississippi river overflowed its banks at every considerable rise. Loaded with detritus, it suddenly spread over its banks to the dimensions of an inland sea; its velocity was thereby checked and much of its load was quickly deposited, the greater part, including the coarsest material, falling on its immediate banks, which were thereby built up higher than the adjoining country. The river and bayous of this region flow on the tops of ridges of their own construction, the only land above the swamps. The highest ground everywhere is that on the immediate river bank, whence the slope is away from the stream on either hand to the swamp, as shown in Pl. XV.

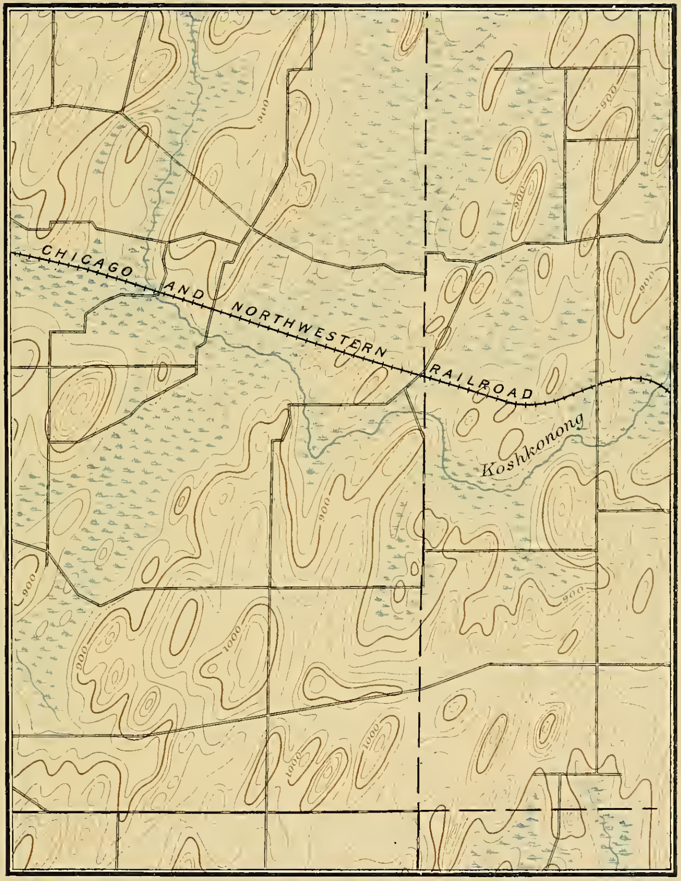
Now, let this operation be extended farther. As a stream builds its ridge higher it soon reaches a condition of instability and it then forsakes its bed for an adjoining lower course. It builds this up and in turn abandons it. So in time it builds up a dry delta, or, as it is called, a fan, made up of a radiating group of abandoned ridges marking its former courses.

Lake terraces are formed by the collection of material at the water's edge. Whether brought down by gravity alone or transported by water, its descent is checked on reaching the water and it accumulates at the water's edge.

GLACIAL DEPOSITION.

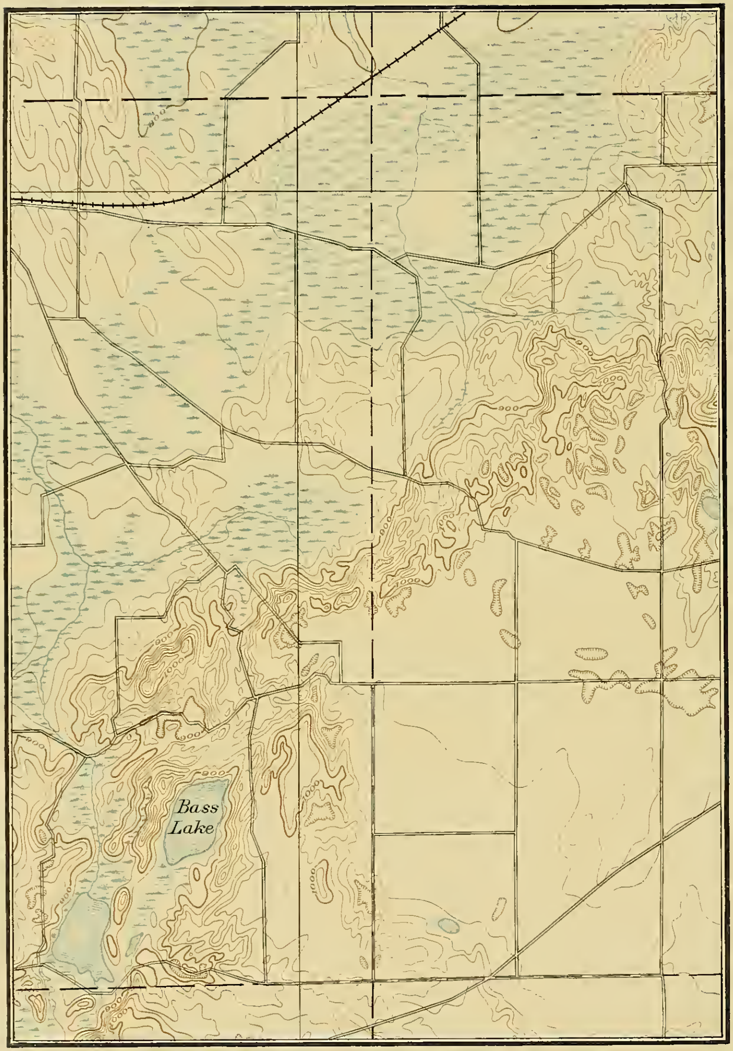
The northern part of the United States was, in recent geologic times, covered by a sheet of ice, a glacier of continental dimensions. Its boundaries, within the United States, included New England, New York, northern Pennsylvania, Ohio, Indiana and Illinois, all of Michigan, Wisconsin, Minnesota and the Dakotas, much of Iowa, and northeastern Montana. The glacier had a southern movement, but this advance southward was, on the whole, neutralized by the melting of the ice on the southern border. In cold seasons, the movement of the glacier gained on the power of the sun's heat to melt it, and it advanced southward. In warm seasons, it retreated northward. The action of this glacier in originating and modifying topographic forms was twofold. It eroded and carried away material and it deposited material. It is the latter result that is considered here.

The material, consisting of bowlders, gravel, and sand borne by the glacier was deposited as it melted, and consequently is most abundantly distributed in the neighborhood of its southern boundary. Owing to the recent character of the deposits, they have been little eroded. Lakes, swamps and waterfalls abound in the region in question. The terminal moraines which mark the limits of the glacier consist of an irregular mass of material, thrown down in the greatest confusion, with crooked winding streams and sink holes. There is no symmetry or law in its disposition, but it is made up of details, which bear no relation to its whole. On this account it must be sketched piecemeal. The topographer must go all over it, picking up each detail by itself, and necessarily the control must be equally minute.


CHICAGO AND NORTHWESTERN RAILROAD
Koshkonong
900
1000

DRUMLINS, WIS.

Scale $\frac{1}{62,500}$
Contour Interval 20 feet



A PART OF THE TERMINAL MORAINE AND PITTED PLAIN, WIS.

Scale $\frac{1}{62,500}$
Contour Interval 20 feet

Within the limits of this terminal moraine, the commonest characteristic feature of glacial deposition is the drumlin, an oval mound of drift, of height ranging from a few feet up to several hundred feet, and from one to several square miles in area. They are extremely regular in shape and their curves are round and smooth. In many localities they are so abundant as practically to cover the surface, the intervals between them being level and often marshy. The axes of these drumlins are commonly parallel, giving a curiously artificial appearance to the map. In country otherwise level, they determine the course of the streams, forcing them to wind around their curves. Pl. XVI shows a portion of the drumlin area of southern Wisconsin, and Pl. XVII a part of the terminal moraine of the same region. Pitted plains, which are level areas dotted with little pits, are common features of glacial action. Osars, or long winding ridges, are not uncommon, while numerous other forms, such as kettles, etc., are frequently seen, but are of less importance as topographic features.

Glaciers still exist in the Rocky mountains, the Sierra Nevada, and the Cascade range, though they are by no means as extensive as in former times. At the bases of many of the ranges of this region are found lateral moraines reaching out from the mouths of mountain gorges and connected at their ends by terminal moraines.

The lateral moraines are of regular form, stretching in narrow ridges, in some cases parallel, in others curving away from one another from the foot of the canyon. The terminal moraines are like that of the continental glacier, confused masses of material heaped up in disorder and consequently difficult to sketch in the highest degree.

GLACIAL EROSION.

Glacial erosion is very similar in its laws and action to aqueous erosion, or rather to that part of it which is called corrasion. The principal difference between them lies in the fact that ice is much less plastic and consequently does not accommodate itself so readily to the form of its channel. It moves, too, much more slowly and in far greater volume than water.

The corrading effect of the continental glacier is shown in northern New England, New York, Michigan, Wisconsin, and Minnesota very markedly. In the western part of this region it has scoured the surface, cutting away the soft rocks, and leaving the hard ones in projecting knobs, as in the Marquette Iron range of Michigan. This work was done so recently that the drainage systems have not yet been well developed. The streams are tortuous and are interrupted by lakes, swamps, and rapids.

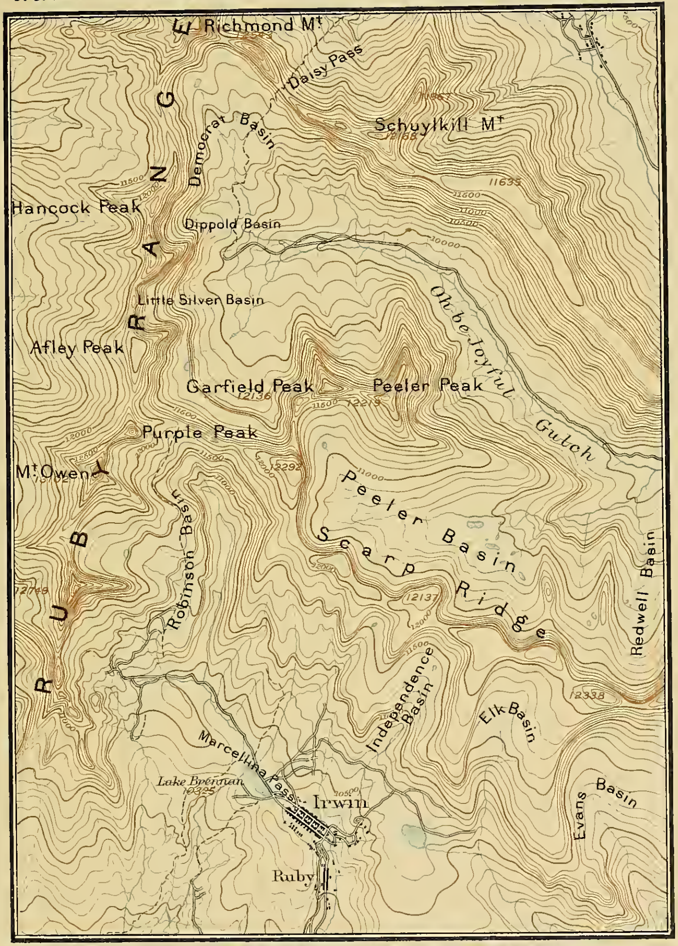
In northern New England and New York the glacier covered a region of considerable relief, in which streams had established deep courses. Much corrasion was done by it, but upon its retreat the streams reoccupied their former beds.

Most of the gorges of the Rocky mountains and Sierra Nevada, which had previously been excavated by streams, have been occupied by glaciers, and here and there small glaciers may still be found at their heads. These glaciers, when they were in their prime, occupied the gorges from side to side, and by their erosion broadened them from the sharp almost V shape which water corrasion had given them to a ◡ shape, similar to that of the bed of a stream, but many times larger.

At the heads of the main gorge and many of its branches, where the névé fields formerly united and were crowded together into a glacier at the heads of the gorges, there is commonly an amphitheater with steep, even precipitous, walls, curving around in a semicircle. In the middle of this is sometimes a lake or pond, with a rim of rock inclosing it on the lower side. This lake basin was scooped out by the glacial ice, as it came together down the steep slopes of the amphitheater. Here the ice has only modified and shaped a gorge originally carved by water. Where the little streams, flowing toward one another down the steep mountain side, had cut many little gorges, with sharp spurs between them, the ice has pared away the spurs, producing an amphitheater. Pl. xviii illustrates the cirque in the Rocky mountains of Colorado.

DEPOSITION FROM THE ATMOSPHERE.

The winds transport sand and deposit it in drifts, known as dunes, They commonly appear as lines of hills, like hogbacks, with the gentle slope toward the prevailing winds. Not having been shaped by erosion. they present great inequalities of surface.


Richmond Mt
Daisy Pass
Schuylkill Mt
12168
11635
Democrat Basin
Hancock Peak
Dippold Basin
RUBY RANGE
Little Silver Basin
Afley Peak
Garfield Peak
12136
Peeler Peak
12219
Oh-be-Joyful Gutch
Purple Peak
Mt Owen
12292
Peeler Basin
Scarp Ridge
12137
Robinson Basin
12749
Redwell Basin
12338
Independence Basin
Elk Basin
Marcellina Pass
Lake Brennan
10325
Irwin
Ruby
Evans Basin

A PORTION OF THE ELK MTS., COL., SHOWING AMPHITHEATRES.

Scale $\frac{1}{62,500}$
Contour Interval 100 feet

SCALE OF FIELD WORK.

The scale upon which the field work is executed is commonly larger than that upon which the maps are to be published. In the northeastern states it is set at 1:45000, the scale of publication being 1:62500. In the southeastern States it is approximately 1 mile to an inch, the scale of publication being for most sheets 1:125000, though certain sheets in Maryland and Florida have been published on the scale 1:62500. In the Mississippi valley it is uniformly about double that of publication. Where the scale of publication is 1:62500, the scale of field work is 2 inches to 1 mile, and where the former is 1:125000, the latter is 1 mile to an inch. In the western states, the scale of publication being 1:125000, the field sheets are made uniformly on the scale of 1 mile to an inch.

REPORTS.

Each field party is required to make a monthly report to the chief of division and the chief topographer upon the progress of the work in his party during the month. In the case of topographic parties these reports are made upon printed forms, of which the following is a sample:

MONTHLY REPORT OF TOPOGRAPHIC PARTY.

[To be made out in duplicate promptly at the close of each month, one copy to be sent to the geographer in charge of the division and one copy to the chief topographer.]

Department of the Interior, U. S. Geological Survey,

——— ———

——— ———, 189 .

Sir: The following report for the month of ———, 189 , includes a statement of progress of the topographic party under my charge:

Names and positions of all members of party, ——— ——— ——— ———.

Instruments used, ——— ——— ——— ———.

	Barnard.	Miller.	Beall.	Arrick.
Days of field work				
Triangulation stations occupied				
Points located by triangulation				
Miles traversed				
Traverse stations				
Points intersected from traverse				
Elevations by vertical angles				
Elevations by aneroid				
Area sketched				

Expended—for salaries, $———; all other expenses, $———; total, $———.

Yours respectfully,

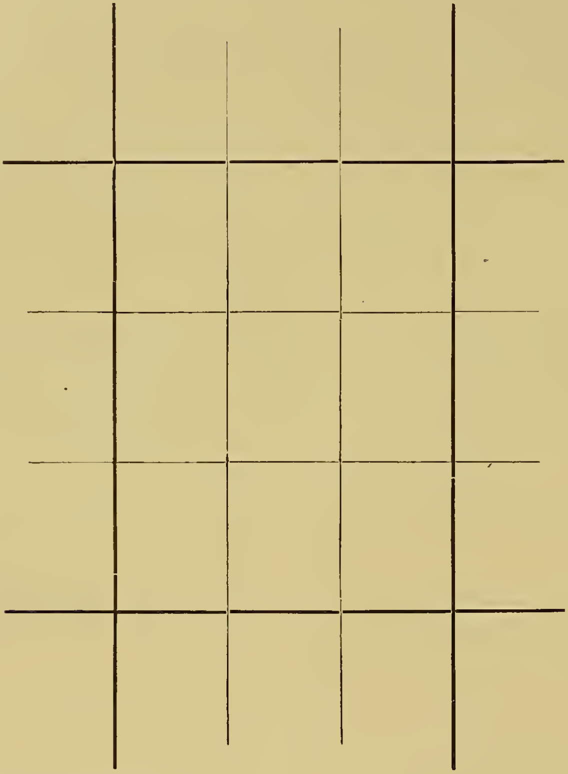
——— ———,

——— ———.

To ——— ———,

——— ———.

REMARKS:



——— Sheet. Shade surveyed area.

Upon the back of this form is a diagram representing an atlas sheet, as above, upon which is to be indicated the area surveyed during the month.

As will be seen, this report calls for statistics concerning the control of work, specifying secondary triangulation, traverse and the measurements of height, together with the areas sketched.

INSPECTION.

Inspection of the work is done by the chiefs of parties and of divisions, and, in special cases, by persons detailed by them for this purpose.

The accuracy and adequacy of the control are shown by the monthly reports and the field sheets are undergoing constant examination from the chiefs of party and of division. The quality of the sketching is examined on the ground. As far as possible this is done during the progress of the work, using the field sheets as soon as completed. When this is impracticable, it is done during the succeeding field season, using photographs of the original maps.

CHAPTER VI.

OFFICE WORK.

The office work of the topographers consists in the reduction and transfer of the work from field sheets to the original maps. The reduction is universally effected by photography, this method having been found the most accurate and economical way of effecting it.

The original sheets are to serve as the original record of work and as manuscript for the engraver. To answer these purposes, they are made complete in all respects as to hydrography, hypsography, and public culture. Every original sheet contains within itself all matter which is to be engraved or placed on record, except as hereafter noted.

While it is entirely unnecessary that these sheets be fine specimens of the draftman's skill, they are workmanlike in appearance, clear, and legible.

The original sheets are commonly drawn upon the scale upon which they are to be published, in order that the engraving may be done directly from the original maps rather than from photographs of them. Frequent departures are, however, made from this rule, to meet other requirements.

The contour intervals differ widely in different parts of the country, ranging from 5 feet up to 100 feet. Where the scale is 1 : 62500 the commonest contour interval is 20 feet. In Florida and Illinois the contour interval is reduced to 10 feet, while in the low alluvial regions of southern Louisiana it is only 5 feet.

With a scale of 1 : 125000 the contour interval in the Appalachian mountain region is 100 feet, in the Piedmont region it is 50 feet, and upon the Atlantic plain 20 feet, while in the Dismal swamp of Virginia and North Carolina it has been set at 5 feet. With the same scale in Missouri, Arkansas, and eastern Kansas the contour interval is 50 feet, while in western Kansas in more recent work it is 20 feet. In Texas the contour interval ranges from 20 to 50 feet, the later work having the smaller contour interval. In the country west of the one hundredth meridian the contour interval is frequently changed with the alternation of mountain and valley, and intervals of 25, 50, and 100 feet are employed, the interval frequently changing upon the same sheet. East of the one hundredth meridian the same necessity for making frequent changes in contour interval does not exist, and in the work throughout that region the contour interval is uniform upon each sheet.

The projection used is the polyconic, each sheet being projected separately.

Upon originals to be published upon a scale of 1 : 62500 the projection interval is 5 minutes, while single minute lines may be drawn if desired.

The construction of a projection upon a scale of 1 : 62500 for a limited area is a simple matter, but requires care and accuracy and the use of the best drafting instruments. The process will be described for this scale, for which, as well as all other scales heretofore in use, tables are appended to this volume.

First draw a line down the middle of the sheet. Lay off on this line the length of the several projection spaces in latitude. Take from the projection table for the scale 1:62500 the length of 5 minutes of latitude and lay it off repeatedly, thus establishing the points of intersection of parallels at 5 minutes with the middle meridian. Through these points draw lines across the sheet at right angles to the middle meridian, using beam compasses for this purpose. Lay off on these lines the dm's for 2′ 30″ and 7′ 30″ from the middle meridian, corresponding to the latitude on each side, and at these points erect short perpendiculars. On these lay off the dp's corresponding to the dm's and through the points thus obtained draw and ink the projection lines.

For other scales and areas the process is quite similar, but when a large area such as that of the United States is to be projected, the mechanical difficulties greatly increase.

Original sheets must conform in size and shape to equal parts of square degrees—i. e., each sheet should comprise 15′ of latitude by 15′ of longitude, or 30′ in each dimension, according to the scale.

COLORS AND CONVENTIONS.

The work upon the original sheets conforms to the system of conventions and lettering adopted by the Survey. Streams must be inked in heavy Prussian blue, lettering and culture in India ink, and contours in burnt sienna. Indelible inks must not be used on original sheets. Every fourth, or fifth contour, whatever the contour interval, should be emphasized, in order to distinguish it from the others, and the contours so distinguished should be freely marked in columns with the number of feet above sea level which they indicate.

Upon the map should be located all towns of sufficient importance to contain post-offices; all railway stations and other settlements of any importance; all houses, all public roads, and, in unsettled regions, the principal trails; all railroads, canals, and acequias; all tunnels of sufficient length to be represented; bridges, ferries, fords, and dams upon streams of sufficient importance to be double-lined; all glaciers, marshes, sand, and sand dunes, and all state, county, and township lines.

The convention for cities and towns must conform as closely as possible, in extent, direction of streets, etc., to the actual plan of the place, and the houses in the built portion should be blocked in.

Depression contours should, if they inclose large areas, be indicated by numbering them freely. If the area is small, they should be hatched, the hatchings being on the side of the line toward the depression.

The extent of forests and of flood plains will not be placed upon the original maps, but should be colored upon photographs of them.

TITLES AND LEGENDS.

The sheets are without border or neat line, the outer projection lines taking the place of the latter. Upon the margins the latitudes and longitudes of the projection lines must be given. The titles and legends must conform in arrangement and character to those on the printed sheets.

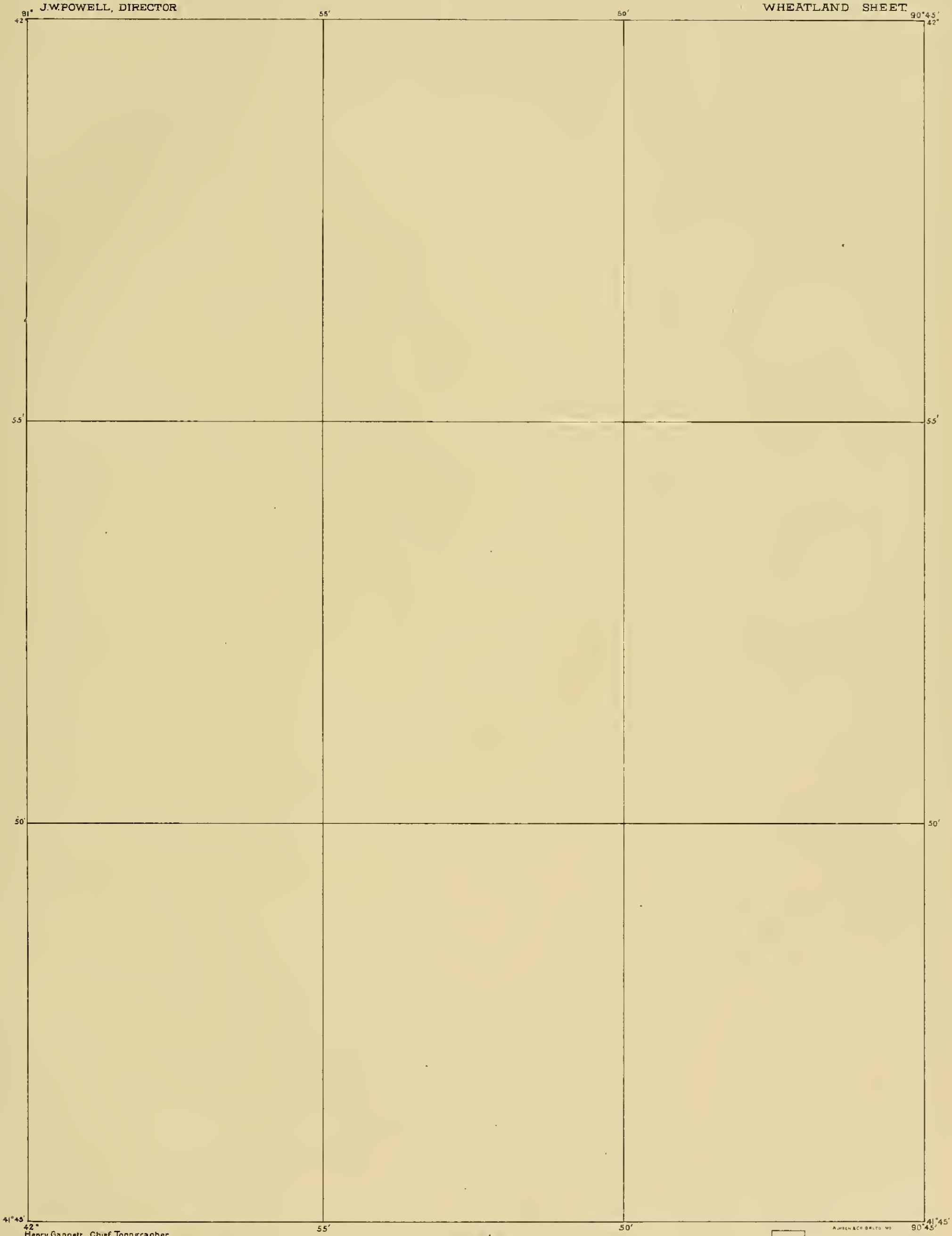
Wherever it is practicable to do so, care must be taken to connect the contours, streams, and culture on the margins of sheets with the adjoining sheets.

All field work should, if possible, be platted and the work completed during the office season immediately succeeding the field work, and no sheet should be reported as completed until it is ready in all respects to be engraved.

ORIGINAL SHEET.

U.S GEOLOGICAL SURVEY
J.W.POWELL, DIRECTOR

IOWA
WHEATLAND SHEET


91°
42°
55′
50′
90°45′
42°
55′
55′
50′
50′
41°45′
42°
55′
50′
41°45′
90°45′

Henry Gannett, Chief Topographer.
Jno. H. Renshawe, Geographer in charge.
Topography by W. J. Peters and R. M. Towson

Surveyed in 1889.

Scale $\frac{1}{62,500}$

0 ½ 1 2 3 4 5 Miles

Contour Interval 20 feet

Peters
Towson

APPENDIX.

TABLES FOR COMPUTING THE DIFFERENCE IN THE HEIGHT OF TWO PLACES FROM BAROMETRICAL OBSERVATIONS.

TABLE. I.—$D=60158.58 \times \log H$ *or* h. *Argument: The observed height of the barometer at either station.*

[Extracted from Smithsonian Miscellaneous Contributions.]

Barometer in Eng. inch.	Hundredths of an inch.										Thousandths of an inch.		Barometer in Eng. inch.
	.00	**.01**	**.02**	**.03**	**.04**	**.05**	**.06**	**.07**	**.08**	**.09**			
	Eng. ft.	*Eng. ft.*	*Eng. ft.*	*Eng. ft.*	*Eng. ft.*	*Eng. ft.*	*Eng. ft.*	*Eng. ft.*	*Eng. ft.*	*Eng. ft.*		*Feet.*	
12.0	4763.4	4785.2	4806.9	4828.7	4850.4	4872.1	4893.7	4915.4	4937.0	4958.6			12.0
12.1	4980.2	5001.8	5023.4	5044.9	5066.4	5087.9	5109.4	5130.9	5152.4	5173.8			12.1
12.2	5195.2	5216.6	5238.0	5259.4	5280.7	5302.1	5323.4	5344.7	5367.0	5387.2			12.2
12.3	5408.5	5429.8	5452.0	5472.2	5493.4	5514.5	5535.7	5556.8	5578.9	5599.0	1	2.1	12.3
12.4	5620.1	5641.2	5662.2	5683.2	5704.3	5725.3	5746.2	5767.2	5788.1	5809.0	2	4.2	12.4
12.5	5829.9	5850.8	5871.7	5892.6	5913.4	5934.2	5955.0	5975.8	5996.6	6017.4	3	6.2	12.5
12.6	6038.1	6058.8	6079.6	6100.2	6120.9	6141.6	6162.2	6182.8	6203.5	6224.0	4	8.3	12.6
12.7	6244.6	6265.2	6285.8	6306.3	6326.8	6347.3	6367.8	6388.3	6408.8	6429.2	5	10.4	12.7
12.8	6449.6	6470.0	6490.4	6510.8	6531.1	6551.5	6571.8	6592.1	6612.4	6632.7	6	12.5	12.8
12.9	6652.9	6673.2	6693.4	6713.6	6733.8	6754.0	6774.1	6794.3	6814.4	6834.5	7	14.6	12.9
13.0	6854.7	6874.7	6894.8	6914.9	6934.9	6955.0	6975.0	6995.0	7014.9	7034.9	8	16.6	13.0
13.1	7054.9	7074.8	7094.7	7114.6	7134.5	7154.4	7174.3	7194.1	7213.9	7233.8	9	18.7	13.1
13.2	7253.6	7273.3	7293.1	7312.9	7332.6	7352.3	7372.1	7391.8	7411.4	7431.1			13.2
13.3	7450.8	7470.4	7490.0	7509.6	7529.2	7548.8	7568.4	7587.9	7607.4	7627.0			13.3
13.4	7646.5	7666.0	7685.4	7704.9	7724.4	7743.8	7763.2	7782.6	7802.0	7821.4			13.4
13.5	7840.8	7860.1	7879.4	7898.7	7918.0	7937.3	7956.6	7975.8	7995.1	8014.3			13.5
13.6	8033.6	8052.8	8071.9	8091.1	8110.3	8129.4	8148.6	8167.7	8186.8	8205.9			13.6
13.7	8225.0	8244.0	8263.1	8282.1	8301.1	8320.1	8339.1	8358.1	8377.1	8396.0	1	1.9	13.7
13.8	8415.0	8433.9	8452.8	8471.7	8490.6	8509.4	8528.3	8547.1	8565.9	8574.8	2	3.8	13.8
13.9	8603.6	8622.3	8641.1	8659.9	8678.6	8697.4	8716.1	8734.8	8753.5	8772.2	3	5.6	13.9
14.0	8790.8	8809.5	8828.2	8846.8	8865.4	8884.0	8902.6	8921.2	8939.7	8958.3	4	7.5	14.0
14.1	8976.8	8995.4	9013.9	9032.4	9050.8	9069.3	9087.8	9106.2	9124.6	9143.0	5	9.4	14.1
14.2	9161.4	9179.8	9198.2	9216.6	9234.9	9253.3	9271.6	9289.9	9308.2	9326.5	6	11.3	14.2
14.3	9344.7	9363.0	9381.3	9399.5	9417.7	9436.0	9454.2	9472.3	9490.5	9508.7	7	13.2	14.3
14.4	9526.8	9545.0	9563.1	9581.2	9599.3	9617.4	9635.5	9653.5	9671.6	9689.6	8	15.0	14.4
14.5	9707.6	9725.7	9743.7	9761.7	9779.6	9797.6	9815.6	9833.5	9851.4	9869.3	9	17.0	14.5
14.6	9887.2	9905.1	9923.0	9940.9	9958.7	9976.5	9994.4	10012.2	10030.0	10047.8			14.6
14.7	10065.5	10083.3	10101.1	10118.8	10136.6	10154.3	10172.0	10189.7	10207.4	10225.1			14.7
14.8	10242.7	10260.4	10278.0	10295.7	10313.3	10330.9	10348.5	10366.1	10383.6	10401.2	1	1.7	14.8
14.9	10418.7	10436.3	10453.8	10471.3	10488.8	10506.3	10523.7	10541.2	10558.6	10576.0	2	3.4	14.9
15.0	10593.4	10610.8	10628.2	10645.6	10662.9	10680.3	10697.6	10715.0	10732.3	10749.6	3	5.1	15.0
15.1	10766.9	10784.1	10801.5	10818.7	10836.0	10853.2	10870.5	10887.7	10904.9	10922.1	4	6.8	15.1
15.2	10939.3	10956.5	10973.6	10990.8	11008.0	11025.1	11042.2	11059.3	11076.4	11093.5	5	8.5	15.2
15.3	11110.6	11127.7	11144.7	11161.8	11178.8	11195.8	11212.8	11229.8	11246.8	11263.8	6	10.2	15.3
15.4	11280.8	11297.8	11314.7	11331.6	11348.6	11365.5	11382.4	11399.3	11416.2	11433.0	7	11.9	15.4
15.5	11449.9	11466.7	11483.6	11500.4	11517.2	11534.0	11550.8	11567.6	11584.4	11601.1	8	13.6	15.5
15.6	11617.9	11634.6	11651.4	11668.1	11684.8	11701.5	11718.2	11734.9	11751.6	11768.2	9	15.3	15.6
15.7	11784.9	11801.5	11818.2	11834.8	11851.4	11868.0	11884.6	11901.1	11917.7	11934.3			15.7
15.8	11950.8	11967.3	11983.8	12000.4	12016.9	12033.3	12049.8	12066.3	12082.7	12099.2			15.8
15.9	12115.6	12132.0	12148.4	12164.8	12181.2	12197.6	12214.0	12230.4	12246.7	12263.1			15.9
16.0	12279.6	12295.9	12312.2	12328.5	12344.8	12361.1	12377.4	12393.6	12409.9	12426.1			16.0
16.1	12442.4	12458.6	12474.8	12491.0	12507.2	12523.4	12539.6	12555.7	12571.9	12588.0			16.1
16.2	12604.2	12620.3	12636.4	12652.5	12668.6	12684.7	12700.8	12716.8	12732.9	12748.9	1	1.6	16.2
16.3	12765.0	12781.0	12797.0	12813.0	12829.0	12845.0	12861.0	12876.9	12892.9	12908.8	2	3.1	16.3
16.4	12924.8	12940.7	12956.6	12972.5	12988.4	13004.3	13020.2	13036.0	13051.9	13067.7	3	4.7	16.4
16.5	13083.6	13099.4	13115.2	13131.0	13146.8	13162.6	13178.4	13194.2	13210.0	13225.7	4	6.3	16.5
16.6	13241.5	13257.2	13272.9	13288.6	13304.3	13320.0	13335.7	13351.5	13367.1	13382.7	5	7.8	16.7
16.7	13398.4	13414.0	13429.6	13445.2	13460.8	13476.4	13492.0	13507.6	13523.2	13538.7	6	9.4	16.7
16.8	13554.3	13569.8	13585.4	13600.9	13616.4	13631.9	13647.4	13662.9	13678.4	13693.9	7	11.0	16.8
16.9	13709.4	13724.8	13740.3	13755.7	13771.1	13786.5	13801.9	13817.3	13832.7	13848.1	8	12.5	16.9
17.0	13863.5	13878.8	13894.2	13909.6	13924.9	13940.2	13955.6	13970.9	13986.2	14001.5	9	14.1	17.0
17.1	14016.8	14032.0	14047.3	14062.6	14077.8	14093.0	14108.3	14123.5	14138.7	14153.9			17.1
17.2	14169.1	14184.3	14199.4	14214.6	14229.8	14244.9	14260.1	14275.2	14290.3	14305.5			17.2
17.3	14320.6	14335.7	14350.8	14365.8	14380.9	14396.0	14411.0	14426.1	14441.1	14456.2			17.3
17.4	14471.2	14486.2	14501.2	14516.2	14531.2	14546.1	14561.1	14576.1	14591.0	14605.9	1	1.5	17.4

TABLE I.—D=60158.58 *log*×H *or h*. *Argument: The observed height of barometer at either station.*—Cont'd.

Barometer in Eng. inch.	Hundredths of an inch.										Thousandths of an inch.		Barometer in Eng. inch.
	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09			
	Eng.ft.	*Eng.ft.*	*Eng.ft.*	*Eng.ft.*	*Eng.ft.*	*Eng.ft.*	*Eng.ft.*	*Eng.ft.*	*Eng.ft.*	*Eng.ft.*		*Feet.*	
17.5	14620.9	14635.8	14650.7	14664.6	14680.5	14695.4	14710.3	14725.2	14740.1	14754.9	2	2.9	17.5
17.6	14769.8	14784.6	14799.4	14814.3	14829.1	14843.9	14858.7	14873.5	14888.2	14903.0	3	4.4	17.6
17.7	14917.8	14932.5	14947.3	14962.0	14976.8	14991.5	15006.2	15020.9	15035.6	15050.3	4	5.8	17.7
17.8	15065.0	15079.6	15094.3	15109.0	15123.6	15138.2	15152.9	15167.5	15122.1	15196.7	5	7,3	17.8
17.9	15211.3	15225.9	15240.5	15255.0	15269.6	15284.2	15298.7	15313.3	15327.8	15342.4	6	8.8	17.9
18.0	15356.8	15371.3	15385.8	15400.3	15414.8	15429.3	15443.7	15458.2	15472.7	15487.1	7	10.2	18.0
18.1	15501.5	15516.0	15530.4	15544.8	15559.2	15573.6	15588.0	15602.4	15616.8	15631.2	8	11.7	18.1
18.2	15645.5	15659.9	15674.2	15688.5	15702.9	15717.2	15731.5	15745.8	15760.1	15774.4	9	13.1	18.2
18.3	15788.6	15802.9	15817.2	15831.4	15845.7	15859.9	15874.2	15888.4	15902.6	15916.8			18.3
18.4	15931.0	15945.2	15959.4	15973.6	15987.8	16001.9	16016.1	16030.2	16044.4	16058.5			18.4
18.5	16072.6	16086.8	16100.9	16115.0	16129.1	16143.2	16157.3	16171.3	16185.4	16199.5			18.5
18.6	16213.5	16227.6	16241.6	16255.6	16269.7	16283.7	16297.7	16311.7	16325.7	16339.6			18.6
18.7	16353.5	16367.5	16381.5	16395.4	16409.4	16423.3	16437.2	16451.2	16465.1	16479.0	1	1.4	18.7
18.8	16492.9	16506.8	16520.7	16534.6	16548.5	16562.3	16576.2	16590.0	16603.9	16617.8	2	2.7	18.8
18.9	16631.5	16645.4	16659.2	16673.0	16686.8	16700.6	16714.4	16728.1	16741.9	16755.7	3	4.1	18.9
19.0	16769.4	16783.2	16796.9	16810.6	16824.3	16838.1	16851.8	16865.5	16879.2	16892.8	4	5.4	19.0
19.1	16906.5	16920.2	16933.9	16947.5	16961.2	16974.9	16988.5	17002.1	17015.8	17029.4	5	6.8	19.1
19.2	17043.0	17056.6	17070.2	17083.8	17097.4	17110.9	17124.5	17138.1	17151.6	17165.2	6	8.1	19.2
19.3	17178.7	17192.2	17205.8	17219.3	17232.8	17246.3	17259.8	17273.3	17286.8	17300.3	7	9.5	19.3
19.4	17313.7	17327.2	17340.6	17354.1	17367.5	17380.9	17394.4	17407.8	17421.2	17434.6	8	10.9	19.4
19.5	17448.0	17461.4	17474.8	17488.2	17501.6	17515.0	17528.3	17541.7	17555.0	17568.4	9	12.2	19.5
19.6	17581.7	17595.0	17608.3	17621.7	17635.0	17648.2	17661.5	17674.8	17688.1	17701.4			19.6
19.7	17714.6	17727.9	17741.1	17754.4	17767.6	17780.8	17794.1	17807.3	17820.5	17833.7			19.7
19.8	17846.9	17860.1	17873.3	17886.5	17899.6	17912.8	17926.0	17939.1	17952.2	17965.4			19.8
19.9	17978.5	17991.6	18004.8	18017.9	18031.0	18044.1	18057.2	18070.3	18083.4	18096.4	1	1.3	19.9
20.0	18109.5	18122.6	18135.6	18148.7	18161.7	18174.8	18187.8	18200.8	18213.8	18226.8	2	2.6	20.0
20.1	18239.8	18252.8	18265.8	18278.8	18291.8	18304.8	18317.7	18330.7	18343.6	18356.6	3	3.9	20.1
20.2	18369.5	18382.5	18395.4	18408.3	18421.2	18434.1	18447.0	18459.9	18472.3	18485.7	4	5.1	20.2
20.3	18498.5	18511.4	18524.3	18537.1	18550.0	18562.8	18575.7	18588.5	18601.3	18614.1	5	6.4	20.3
20.4	18626.9	18639.7	18652.5	18665.3	18678.1	18690.9	18703.6	18716.4	18729.1	18741.9	6	7.7	20.4
20.5	18754.6	18767.4	18780.1	18792.9	18805.6	18818.3	18831.0	18843.7	18856.4	18869.1	7	9.0	20.5
20.6	18881.8	18894.5	18907.2	18919.9	18932.5	18945.2	18957.8	18970.5	18983.1	18995.7	8	10.3	20.6
20.7	19008.3	19021.0	19033.6	19046.2	19058.8	19071.4	19083.9	19096.5	19109.1	19121.7	9	11.6	20.7
20.8	19134.2	19146.8	19159.3	19171.9	19184.4	19196.9	19209.5	19222.0	19234.5	19247.0			20.8
20.9	19259.5	19272.0	19284.5	19297.1	19309.5	19322.0	19334.4	19346.9	19359.3	19371.8			20.9
21.0	19384.3	19396.7	19409.1	19421.5	19434.0	19446.4	19458.8	19471.2	19483.6	19496.0	1	1.2	21.0
21.1	19508.4	19520.8	19533.1	19545.5	19557.9	19570.2	19589.6	19594.9	19607.3	19619.6	2	2.4	21.1
21.2	19632.0	19644.3	19656.6	19668.9	19681.2	19693.5	19705.8	19718.0	19730.3	19742.6	3	3.6	21.2
21.3	19754.9	19767.1	19779.4	19791.6	19803.9	19816.1	19828.4	19840.6	19852.8	19865.0	4	4.8	21.3
21.4	19877.3	19889.5	19901.7	19913.9	19926.0	19938.2	19950.4	19962.6	19974.7	19986.9			21.4
21.5	19999.1	20011.2	20023.3	20035.5	20047.6	20059.7	20071.8	20083.9	20096.1	20108.2	5	6.0	21.5
21.6	20120.3	20132.3	20144.4	20156.5	20168.6	20180.7	20192.7	20204.8	20216.9	20228.9	6	7.2	21.6
21.7	20241.0	20253.0	20265.9	20277.6	20289.1	20301.1	20313.1	20325.1	20337.1	20349.1	7	8.4	21.7
21.8	20361.1	20373.0	20385.0	20397.0	20409.0	20420.9	20432.9	20444.8	20456.8	20468.7	8	9.7	21.8
21.9	20480.7	20492.6	20504.5	20516.4	20528.3	20540.2	20552.1	20564.0	20575.9	20587.8	9	10.9	21.9
22.0	20599.7	20611.5	20623.4	20635.3	20647.1	20659.0	20670.8	20682.7	20694.5	20706.3			22.0
22.1	20718.2	20732.0	20741.8	20753.6	20765.4	20777.2	20789.0	20801.8	20812.6	20824.4			22.1
22.2	20836.2	20847.9	20859.7	20871.4	20883.2	20894.9	20906.7	20918.4	20930.1	20941.9			22.2
22.3	20953.6	20965.3	20977.0	20988.7	21000.4	21012.1	21023.8	21035.4	21047.1	21058.8	1	1.1	22.3
22.4	21070.5	21082.1	21093.8	21105.4	21117.1	21128.7	21140.4	21152.0	21163.6	21175.3	2	2.3	22.4
22.5	21186.9	21198.5	21210.1	21221.6	21233.2	21244.8	21256.4	21268.0	21279.5	21291.1	3	3.4	22.5
22.6	21302.6	21314.2	21325.8	21337.3	21348.9	21360.4	21371.9	21383.5	21395.0	21406.5	4	4.6	22.6
22.7	21418.1	21429.6	21441.1	21452.5	21464.0	21465.5	21487.0	21498.5	21509.9	21521.4	5	5.7	22.7
22.8	21532.9	21544.3	21555.8	21567.2	21578.7	21590.1	21601.6	21613.0	21624.4	21635.8	6	6.8	22.8
22.9	21647.3	21658.7	21670.1	21681.4	21692.8	21704.2	21715.6	21727.0	21738.3	21749.7	7	8.0	22.9
23.0	21761.0	21772.4	21783.7	21795.1	21806.4	21817.7	21829.1	21840.4	21851.7	21863.0	8	9.1	23.0
23.1	21874.3	21885.6	21897.0	21908.3	21919.6	21930.8	21942.1	21953.4	21964.7	21976.0	9	10.2	23.1
23.2	21987.2	21998.5	22009.8	22021.0	22032.3	22043.5	22054.7	22066.0	22077.2	22088.4			23.2
23.3	22099.6	22110.8	22122.1	22133.3	22144.5	22155.6	22166.8	22178.0	22189.2	22200.4			23.3
23.4	22211.5	22222.7	22233.9	22245.0	22256.2	22267.3	22278.4	22289.6	22300.7	22311.8			23.4
23.5	22322.9	22334.0	22345.2	22356.3	22367.4	22378.4	22389.5	22400.6	22411.7	22422.8			23.5
23.6	22433.8	22444.9	22456.0	22467.0	22478.1	22489.1	22500.2	22511.2	22522.3	22533.3			23.6
23.7	22544.3	22555.4	22566.4	22577.4	22588.4	22599.4	22610.4	22621.4	22632.4	22643.4			23.7
23.8	22654.3	22665.3	22676.3	22687.2	22698.2	22709.1	22720.1	22731.0	22742.0	22752.9	1	1.1	23.8
23.9	22763.8	22774.8	22785.7	22796.6	22807.5	22818.4	22829.4	22840.3	22851.2	22862.0	2	2.2	23.9
24.0	22873.0	22883.9	22894.7	22905.6	22916.5	22927.4	22938.2	22949.1	22960.0	22970.8	3	3.2	24.0
24.1	22981.7	22992.5	23003.3	23014.2	23025.0	23035.8	23046.6	23057.5	23068.3	23079.1	4	4.3	24.1
34.2	23089.9	23100.7	23111.4	23122.2	23133.0	23143.8	23154.5	23165.3	23176.1	23186.8	5	5.4	24.2
24.3	23197.6	23208.3	23219.1	23229.8	23240.5	23251.3	23262.0	23272.7	23283.4	23294.2	6	6.5	24.3
24.4	23304.9	23315.6	23326.3	23337.0	23347.6	23358.3	23369.0	23379.7	23390.3	23401.0	7	7.5	24.4

TABLE. I.—D=60158.58 × *log* H *or h. Argument: The observed height of the barometer at either station*—Continued.

Barometer in Eng. inch.	Hundredths of an inch.										Thousandths of an inch.		Barometer in Eng. inch.
	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09			
	Eng. ft.	*Eng. ft.*	*Eng. ft*	*Eng. ft.*	*Eng. ft.*	*Eng. ft.*	*Eng. ft.*	*Eng. ft.*	*Eng. ft.*	*Eng. ft.*		*Feet.*	
24.5	23411.7	23422.3	23433.0	23443.7	23454.3	23464.9	23475.6	23486.2	23496.8	23507.4	8	8.6	24.5
24.6	23518.1	23528.7	23539.3	23549.9	23560.5	23571.1	23581.7	23592.3	23602.9	23613.5	9	9.7	24.6
24.7	23624.1	23634.6	23645.2	23655.8	23666.3	23676.9	23687.5	23698.0	23708.6	23719.1			24.7
24.8	23729.7	23740.2	23750.7	23761.2	23771.7	23782.3	23792.8	23803.3	23813.8	23824.3			24.8
24.9	23834.8	23845.3	23855.7	23866.2	23876.7	23887.2	23897.7	23908.2	23918.6	23929.1	1	1.0	24.9
25.0	23939.5	23949.9	23960.4	23970.8	23981.3	23991.7	24002.1	24012.5	24023.0	24033.4	2	2.1	25.0
25.1	24043.8	24054.2	24064.6	24075.0	24085.4	24095.7	24106.1	24116.5	24126.9	24137.2	3	3.1	25.1
25.2	24147.6	24158.0	24168.3	24178.7	24189.0	24199.4	24209.7	24220.1	24230.4	24240.8	4	4.1	25.2
25.3	24251.1	24261.4	24271.8	24282.1	24292.4	24302.7	24313.0	24323.3	24333.6	24343.9	5	5.1	25.3
25.4	24354.2	24364.5	24374.7	24385.0	24395.3	24405.5	24415.8	24426.1	24436.3	24446.6	6	6.2	25.4
25.5	24456.8	24467.0	24477.3	24487.5	24497.8	24508.0	24518.2	24528.4	24538.7	24548.9	7	7.2	25.5
25.6	24559.1	24569.3	24579.5	24589.7	24599.9	24610.0	24620.2	24630.4	24640.6	24650.7	8	8.2	25.6
25.7	24660.9	24671.1	24681.2	24691.4	24701.5	24711.7	24721.8	24732.0	24742.1	24752.3	9	9.2	25.7
25.8	24762.4	24772.5	24782.6	24792.8	24802.9	24813.0	24823.1	24833.2	24843.3	24853.4			25.8
25.9	24863.5	24873.6	24883.7	24893.7	24903.8	24913.9	24921.0	24934.0	24944.1	24954.1			25.9
26.0	24964.2	24974.2	24984.3	24994.3	25004.4	25014.4	25024.4	25034.4	25044.5	25054.5			26.0
26.1	25064.5	25074.5	25084.5	25094.5	25104.5	25114.5	25124.5	25134.5	25144.4	25154.4			26.1
26.2	25164.4	25174.4	25184.3	25194.3	25204.2	25214.2	25224.1	25234.1	25244.0	25254.0	1	1.0	26.2
26.3	25263.9	25273.8	25283.8	25293.7	25303.6	25313.5	25323.4	25333.3	25343.2	25353.1	2	2.0	26.3
26.4	25363.0	25372.9	25382.8	25392.7	25402.6	25412.4	25422.3	25432.2	25442.1	25451.9	3	2.9	26.4
26.5	25461.8	25471.7	25481.5	25491.4	25501.2	25511.0	25520.9	25530.7	25540.5	25550.4	4	3.9	26.5
26.6	25560.2	25570.0	25579.8	25589.7	25599.5	25609.3	25619.1	25628.9	25638.7	25648.5	5	4.9	26.6
26.7	25658.3	25668.1	25677.8	25687.6	25697.4	25707.1	25716.9	25726.7	25736.4	25746.2	6	5.9	26.7
26.8	25755.9	25765.6	25775.4	25785.1	25794.8	25804.6	25814.3	25824.0	25833.8	25843.5	7	6.9	26.8
26.9	25853.2	25862.9	25872.6	25882.3	25892.0	25901.7	25911.4	25921.1	25930.8	25940.5	8	7.8	26.9
27.0	25950.2	25959.9	25969.6	25979.2	25988.9	25998.6	26008.2	26017.9	26027.5	26037.2	9	8.8	27.0
27.1	26046.8	26056.5	26066.1	26075.7	26085.3	26095.0	26104.6	26114.2	26123.8	26133.4			27.1
27.2	26143.0	26152.6	26162.2	26171.8	26181.4	26191.0	26200.6	26210.2	26219.8	26229.3			27.2
27.3	26238.9	26248.0	26258.0	26267.6	26277.2	26286.7	26296.3	26305.8	26315.3	26324.9			27.3
27.4	26334.4	26344.0	26353.5	26363.0	26372.5	26382.1	26391.6	26401.1	26410.6	26420.1	1	0.9	27.4
27.5	26429.6	26439.1	26448.6	26458.1	26467.6	26477.1	26486.5	26496.0	26505.5	26514.9	2	1.9	27.5
27.6	26524.4	26533.9	26543.3	26552.8	26562.3	26571.7	26581.2	26590.6	26600.0	26609.5	3	2.8	27.6
27.7	26618.9	26628.4	26637.8	26647.2	26656.7	26666.1	26675.5	26684.9	26694.3	26703.7	4	3.7	27.7
27.8	26713.1	26722.5	26731.9	26741.3	26750.7	26760.1	26769.5	26778.8	26788.2	26797.6	5	4.7	27.8
27.9	26806.9	26816.3	26825.6	26835.0	26844.3	26853.7	26863.0	26872.3	26881.7	26891.0	6	5.6	27.9
28.0	26900.4	26909.7	21919.0	26928.4	26937.7	26947.0	26956.3	26965.6	26975.0	26984.3	7	6.5	28.0
28.1	26993.6	27002.9	27012.2	27021.5	27030.7	27040.0	27049.3	27058.6	27067.8	27077.1	8	7.5	28.1
28.2	27086.4	27095.6	27104.9	27114.2	27123.4	27132.7	27141.9	27151.2	27160.4	27169.6	9	8.4	28.2
28.3	27178.9	27188.1	27197.3	27206.5	27215.7	27225.0	27234.2	27243.4	27252.6	27261.8			28.3
28.4	27271.0	27280.2	27289.4	27298.6	27307.8	27317.0	27326.2	27335.3	27344.5	27353.7			28.4
28.5	27362.9	27372.0	27381.2	27390.4	27399.5	27408.7	27417.8	27427.0	27436.1	27445.2			28.5
28.6	27454.4	27463.5	27472.6	27481.8	27490.9	27500.0	27509.1	27518.2	27527.4	27536.5			28.6
28.7	27545.6	27554.7	27563.8	27572.9	27582.0	27591.1	27600.2	27609.3	27618.3	27627.4	1	0.9	28.7
28.8	27636.5	27645.5	27654.6	27663.7	27672.7	27681.8	27690.8	27699.9	27708.9	27717.9	2	1.8	28.8
28.9	27727.0	27736.0	27745.1	27754.1	27763.1	27772.2	27781.2	27790.2	27799.2	27808.3	3	2.7	28.9
29.0	27817.2	27826.2	27835.2	27844.2	27853.2	27862.2	27871.2	27880.2	27889.1	27898.1	4	3.6	29.0
29.1	27907.1	27916.1	27925.0	27934.0	27943.0	27951.9	27960.9	27969.8	27978.8	27987.7	5	4.5	29.1
29.2	27996.7	28005.6	28014.6	28023.5	28032.4	28041.4	28050.3	28059.2	28068.2	28077.1	6	5.4	29.2
29.3	28086.0	28094.9	28103.8	28112.8	28121.7	28130.6	28139.5	28148.4	28157.3	28166.2	7	6.3	29.3
29.4	28175.1	28184.0	28192.9	28201.7	28210.6	28219.5	28228.4	28237.2	28246.1	28254.9	8	7.2	29.4
29.5	28263.8	28272.6	28281.5	28290.3	28299.2	28308.0	28316.9	28325.7	28334.5	28343.4	9	8.1	29.5
29.6	28352.2	28361.0	28369.8	28378.7	28387.5	28396.3	28405.1	28413.9	28422.7	28431.5			29.6
29.7	28440.3	28449.1	28457.9	28466,7	28475.4	28484.2	28493.0	28501.8	28510.6	28519.3			29.7
29.8	28528.1	28536.9	28545.6	28554.4	28563.2	28571.9	28580.7	28589.4	28598.2	28606.9			29.8
29.9	28615.7	28624.4	28633.2	28641.9	28650.6	28659.3	28668.1	28676.8	28685.5	28694.2	1	8.6	29.9
30.0	28702.9	28711.6	28720.3	28729.0	28737.7	28746.4	28755.1	28763.8	28772.5	28781.1	2	1.7	30.0
30.1	28789.8	28798.5	28807.2	28815.9	28824.5	28833.2	28841.9	28850.5	28859.2	28867.9	3	2.6	30.1
30.2	28876.5	28885.2	28893.8	28902.5	28911.1	28919.8	28928.4	28937.0	28945.7	28954.3	4	3.4	30.2
30.3	28962.9	28971.5	28980.1	28988.8	28997.4	29006.0	29014.6	29023.2	29031.7	29040.3	5	4.3	30.3
30.4	29048.9	29057.5	29066.1	29074.7	29083.3	29091.8	29100.4	29109.0	29117.6	29126.2	6	5.2	30.4
30.5	29134.7	29143.3	29151.9	29160.4	29169.0	29177.6	29186.1	29194.7	29203.2	29211.8	7	6.0	30.5
30.6	29220.3	29228.9	29237.4	29245.9	29254.4	29262.9	29271.5	29280.0	29288.5	29297.0	8	6.9	30.6
30.7	29305.5	29314.0	29322.5	29331.1	29339.6	29348.1	29356.6	29365.1	29373.5	29382.0	9	7.7	30.7
30.8	29390.5	29399.0	29407.5	29416.0	29424.4	29432.9	29441.4	29449.8	29458.3	29466.8			30.8
30.9	29475.2	29483.7	29492.1	29500.6	29509.0	29517.5	29525.9	29534.3	29542.8	29551.2			30.9

TABLE II.—*Correction for τ—τ′, or difference in the temperature of the barometers at the two stations.*

[This correction is *negative* when the attached thermometer at the upper station is lowest; *positive* when the attached thermometer at the upper station is highest.]

τ—τ′ F.	Correction.	τ—τ′ F.	Correction.	τ—τ′ F.	Correction.	τ—τ′ F.	Correction.	τ—τ′ F.	Correction.	τ—τ′ F.	Correction.	τ—τ′ F.	Correction.	τ—τ′ F.	Correction.	τ—τ′ F.	Correction.	τ—τ′ F.	Correction.
°	*E. ft.*	°	*E. ft.*	°	*E. ft.*	°	*E. ft.*	°	*E. ft.*	°	*E. ft.*	°	*E. ft.*	°	*E. ft.*	°	*E. ft.*	°	*E. ft.*
1.0	2.3	11.0	25.8	21.0	49.2	31.0	72.6	41.0	96.0	51.0	119.5	61.0	142.9	71.0	166.3	81.0	189.7	91.0	213.2
1.5	3.5	11.5	26.9	21.5	50.4	31.5	73.8	41.5	97.2	51.5	120.6	61.5	144.1	71.5	167.5	81.5	190.9	91.5	214.3
2.0	4.7	12.0	28.1	22.0	51.5	32.0	75.0	42.0	98.4	52.0	121.8	62.0	145.2	72.0	168.7	82.0	192.1	92.0	215.5
2.5	5.9	12.5	29.3	22.5	52.7	32.5	76.1	42.5	99.6	52.5	123.0	62.5	146.4	72.5	169.8	82.5	193.3	92.5	216.7
3.0	7.0	13.0	30.5	23.0	53.9	33.0	77.3	43.0	100.7	53.0	124.2	63.0	147.6	73.0	171.0	83.0	194.4	93.0	217.9
3.5	8.2	13.5	31.6	23.5	55.1	33.5	78.5	43.5	101.9	53.5	125.3	63.5	148.8	73.5	172.2	83.5	195.6	93.5	219.0
4.0	9.4	14.0	32.8	24.0	56.2	34.0	79.6	44.0	103.1	54.0	126.5	64.0	149.9	74.0	173.4	84.0	196.8	94.0	220.2
4.5	10.5	14.5	34.0	24.5	57.4	34.5	80.8	44.5	104.2	54.5	127.7	64.5	151.1	74.5	174.5	84.5	197.9	94.5	221.4
5.0	11.7	15.0	35.1	25.0	58.6	35.0	82.0	45.0	105.4	55.0	128.8	65.0	152.3	75.0	175.7	85.0	199.1	95.0	222.5
5.5	12.9	15.5	36.3	25.5	59.7	35.5	83.2	45.5	106.6	55.5	130.0	65.5	153.4	75.5	176.9	85.5	200.3	95.5	223.7
6.0	14.1	16.0	37.5	26.0	60.9	36.0	84.3	46.0	107.8	56.0	131.2	66.0	154.6	76.0	178.0	86.0	201.5	96.0	224.9
6.5	15.2	16.5	38.7	26.5	62.1	36.5	85.5	46.5	108.9	56.5	132.4	66.5	155.8	76.5	179.2	86.5	202.6	96.5	226.1
7.0	16.4	17.0	39.8	27.0	63.2	37.0	86.7	47.0	110.1	57.0	133.5	67.0	157.0	77.0	180.4	87.0	203.8	97.0	227.2
7.5	17.6	17.5	41.0	27.5	64.4	37.5	87.8	47.5	111.3	57.5	134.7	67.5	158.1	77.5	181.6	87.5	205.0	97.5	228.4
8.0	18.7	18.0	42.2	28.0	65.6	38.0	89.0	48.0	112.4	58.0	135.9	68.0	159.3	78.0	182.7	88.0	206.1	98.0	229.6
8.5	19.9	18.5	43.3	28.5	66.8	38.5	90.2	48.5	113.6	58.5	137.0	68.5	160.5	78.5	183.9	88.5	207.3	98.5	230.7
9.0	21.1	19.0	44.5	29.0	67.9	39.0	91.4	49.0	114.8	59.0	138.2	69.0	161.6	79.0	185.1	89.0	208.5	99.0	231.9
9.5	22.3	19.5	45.7	29.5	69.1	39.5	92.5	49.5	116.0	59.5	139.4	69.5	162.8	79.5	186.2	89.5	209.7	99.5	233.1
10.0	23.4	20.0	46.9	30.0	70.3	40.0	93.7	50.0	117.1	60.0	140.6	70.0	164.0	80.0	187.4	90.0	210.8	100.0	234.3
10.5	24.6	20.5	48.0	30.5	71.4	40.5	94.9	50.5	118.3	60.5	141.7	70.5	165.2	80.5	188.6	90.5	212.0	100.5	235.4

TABLE III.—*Correction for the difference of gravity in various latitudes.*

[Correction *positive* from latitude 0° to 45°; *negative* from 45° to 90°.]

Approximate difference of level.	Latitude.																							Approximate difference of level.
	0° 90°	2° 88°	4° 86°	6° 84°	8° 82°	10° 80°	12° 78°	14° 76°	16° 74°	18° 72°	20° 70°	22° 68°	24° 66°	26° 64°	28° 62°	30° 60°	32° 58°	34° 56°	36° 54°	38° 52°	40° 50°	42° 48°	44° 46°	45°	
Eng. ft.	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*Eng. ft.*
1,000	2.6	2.6	2.6	2.5	2.5	2.4	2.4	2.3	2.2	2.1	2.0	1.9	1.7	1.6	1.5	1.3	1.1	1.0	0.8	0.6	0.5	0.3	0.1	0	1,000
2,000	5.2	5.2	5.1	5.1	5.0	4.9	4.7	4.6	4.4	4.2	4.0	3.7	3.5	3.2	2.9	2.6	2.3	1.9	1.6	1.3	0.9	0.5	0.2	0	2,000
3,000	7.8	7.8	7.7	7.6	7.5	7.3	7.1	6.9	6.6	6.3	6.0	5.6	5.2	4.8	4.4	3.9	3.4	2.9	2.4	1.9	1.4	0.8	0.3	0	3,000
4,000	10.4	10.4	10.3	10.2	10.0	9.8	9.5	9.2	8.8	8.4	8.0	7.5	7.0	6.4	5.8	5.2	4.6	3.9	3.2	2.5	1.8	1.1	0.4	0	4,000
5,000	13.0	13.0	12.9	12.7	12.5	12.2	11.9	11.5	11.0	10.5	10.0	9.4	8.7	8.0	7.3	6.5	5.7	4.9	4.0	3.1	2.3	1.4	0.5	0	5,000
6,000	15.6	15.6	15.4	15.3	15.0	14.7	14.3	13.8	13.2	12.6	11.9	11.2	10.4	9.6	8.7	7.8	6.8	5.8	4.8	3.8	2.7	1.6	0.5	0	6,000
7,000	18.2	18.2	18.0	17.8	17.5	17.1	16.6	16.1	15.4	14.7	13.9	13.1	12.2	11.2	10.2	9.1	8.0	6.8	5.6	4.4	3.2	1.9	0.6	0	7,000
8,000	20.8	20.7	20.6	20.3	20.0	19.5	19.0	18.4	17.6	16.8	15.9	15.0	13.9	12.8	11.6	10.4	9.1	7.8	6.4	5.0	3.6	2.2	0.7	0	8,000
9,000	23.4	23.3	23.2	22.9	22.5	22.0	21.4	20.7	19.8	18.9	17.9	16.8	15.7	14.4	13.1	11.7	10.3	8.8	7.2	5.7	4.1	2.4	0.8	0	9,000
10,000	26.0	25.9	25.7	25.4	25.0	24.4	23.8	23.0	22.0	21.0	19.9	18.7	17.4	16.0	14.5	13.0	11.4	9.7	8.0	6.3	4.5	2.7	0.9	0	10,000
11,000	28.6	28.5	28.3	28.0	27.5	26.9	26.1	25.3	24.3	23.1	21.9	20.6	19.1	17.6	16.0	14.3	12.5	10.7	8.8	6.9	5.0	3.0	1.0	0	11,000
12,000	31.2	31.1	30.9	30.5	30.0	29.3	28.5	27.5	26.5	25.2	23.9	22.4	20.9	19.2	17.4	15.6	13.7	11.7	9.6	7.5	5.4	3.3	1.1	0	12,000
13,000	33.8	33.7	33.5	33.1	32.5	31.8	30.9	29.8	28.7	27.3	25.9	24.3	22.6	20.8	18.9	16.9	14.8	12.7	10.4	8.2	5.9	3.5	1.2	0	13,000
14,000	36.4	36.3	36.0	35.6	35.0	34.2	33.3	32.1	30.9	29.4	27.9	26.2	24.4	22.4	20.4	18.2	16.0	13.6	11.2	8.8	6.3	3.8	1.3	0	14,000
15,000	39.0	38.9	38.6	38.1	37.5	36.6	35.6	34.4	33.1	31.6	29.9	28.1	26.1	24.0	21.8	19.5	17.1	14.6	12.1	9.4	6.8	4.1	1.4	0	15,000
16,000	41.6	41.5	41.2	40.7	40.0	39.1	38.0	36.7	35.3	33.7	31.9	29.9	27.8	25.6	23.3	20.8	18.2	15.6	12.9	10.1	7.2	4.3	1.5	0	16,000
17,000	44.2	44.1	43.8	43.2	42.5	41.5	40.4	39.0	37.5	35.8	33.9	31.8	29.6	27.2	24.7	22.1	19.4	16.6	13.7	10.7	7.7	4.6	1.5	0	17,000
18,000	46.8	46.7	46.3	45.8	45.0	44.0	42.8	41.3	39.7	37.9	35.8	33.7	31.3	28.8	26.2	23.4	20.5	17.5	14.5	11.3	8.1	4.9	1.6	0	18,000
19,000	49.4	49.3	48.9	48.3	47.5	46.4	45.1	43.6	41.9	40.0	37.8	35.5	33.1	30.4	27.6	24.7	21.7	18.5	15.3	12.0	8.6	5.2	1.7	0	19,000
20,000	52.0	51.9	51.5	50.4	50.0	48.9	47.5	45.9	44.1	42.1	39.8	37.4	34.8	32.0	29.1	26.0	22.8	19.5	16.1	12.6	9.0	5.4	1.8	0	20,000
21,000	54.6	54.5	54.1	53.4	52.5	51.3	49.9	48.2	46.3	44.2	41.8	39.3	36.5	33.6	30.5	27.3	23.9	20.5	16.9	13.2	9.5	5.7	1.9	0	21,000
22,000	57.2	57.1	56.6	55.9	55.0	53.7	52.3	50.5	48.5	46.3	43.8	41.1	38.3	35.2	32.0	28.6	25.1	21.4	17.7	13.8	9.9	6.0	2.0	0	22,000
23,000	59.8	59.7	59.2	58.5	57.5	56.2	54.6	52.8	50.7	48.4	45.8	43.0	40.0	36.8	33.4	29.9	26.2	22.4	18.5	14.5	10.4	6.2	2.1	0	23,000
24,000	62.4	62.2	61.8	61.0	60.0	58.6	57.0	55.1	52.9	50.5	47.8	44.9	41.8	38.4	34.9	31.2	27.4	23.4	19.3	15.1	10.8	6.5	2.2	0	24,000
25,000	65.0	64.8	64.4	63.6	62.5	61.1	59.4	57.4	55.1	52.6	49.8	46.8	43.5	40.0	36.3	32.5	28.5	24.3	20.1	15.7	11.3	6.8	2.3	0	25,000

TABLE IV.—*Correction for-*

Approximate difference of level.	Decrease of gravity on a vertical. *Positive.*		Approximate difference of level.	Decrease of gravity on a vertical. *Positive.*		Approximate difference of level.	Decrease of gravity on a vertical. *Positive.*	
	0	**+500**		**0**	**+500**		**0**	**+500**
Eng. feet.	*Feet.*	*Feet.*	*Eng. feet.*	*Feet.*	*Feet.*	*Eng. feet.*	*Feet.*	*Feet.*
1,000	2.5	3.9	10,000	29.8	31.5	19,000	64.8	67.0
2,000	5.2	6.6	11,000	33.3	35.1	20,000	69.2	71.4
3,000	7.9	9.3	12,000	36.9	38.7	21,000	73.6	75.9
4,000	10.8	12.2	13,000	40.6	42.5	22,000	78.2	80.5
5,000	13.7	15.2	14,000	44.4	46.3	23,000	82.9	85.2
6,000	16.7	18.3	15,000	48.3	50.3	24,000	87.6	90.0
7,000	19.9	21.5	16,000	52.3	54.3	25,000	92.5	94.9
8,000	23.1	24.7	17,000	56.4	58.4			
9,000	26.4	28.1	18,000	60.5	62.6			

TABLE V.—*Correction for the height of the lower station.—Positive.*

Approximate difference of level.	Height of the barometer, in English inches, at lower station.							Approximate difference of level.	Height of the barometer, in English inches, at lower station.						
	16	**18**	**20**	**22**	**24**	**26**	**28**		**16**	**18**	**20**	**22**	**24**	**26**	**28**
Eng. feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Eng. feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
1,000	1.6	1.3	1.0	0.8	0.6	0.4	0.2	14,000	21.9	17.8	14.1	10.8	7.7	4.9	2.3
2,000	3.1	2.5	2.0	1.5	1.1	0.7	0.3	15,000	23.5	19.1	15.1	11.5	8.3	5.3	2.5
3,000	4.7	3.8	3.0	2.3	1.7	1.1	0.5	16,000	25.1	20.3	16.1	12.3	8.8	5.6	2.7
4,000	6.3	5.1	4.0	3.1	2.2	1.4	0.7	17,000	26.6	21.6	17.1	13.1	9.4	6.0	2.8
5,000	7.8	6.4	5.0	3.8	2.8	1.8	0.8	18,000	28.2	22.9	18.1	13.8	9.9	6.3	3.0
6,000	9.4	7.6	6.0	4.6	3.3	2.1	1.0	19,000	29.8	24.1	19.2	14.6	10.5	6.7	3.2
7,000	11.0	8.9	7.1	5.4	3.9	2.5	1.2	20,000	31.3	25.4	20.2	15.4	11.0	7.0	3.3
8,000	12.5	10.2	8.1	6.2	4.4	2.8	1.3	21,000	32.9	26.7	21.2	16.1	11.6	7.4	3.5
9,000	14.1	11.4	9.1	6.9	5.0	3.2	1.5	22,000	34.5	28.0	22.2	16.9	12.1	7.7	3.7
10,000	15.7	12.7	10.1	7.7	5.5	3.5	1.7	23,000	36.0	29.2	23.2	17.7	12.7	8.1	3.8
11,000	17.2	14.0	11.1	8.5	6.1	3.9	1.8	24,000	37.6	30.5	24.2	18.5	13.2	8.4	4.0
12,000	18.8	15.3	12.1	9.2	6.6	4.2	2.0	25,000	39.1	31.8	25.2	19.2	13.8	8.8	4.1
13,000	20.4	16.5	13.1	10.0	7.2	4.6	2.2								

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile.*

[Prepared by W. J. Peters and Morris Bien.]

EXPLANATION OF THE TABLE.

The top line represents differences of altitude in feet. The first column gives vertical angles in degrees and minutes. The body of the table gives distances in miles and hundredths of a mile, corresponding to the number of feet at the top of the column and the angle at the left of the line. For distances greater than a mile a correction should be applied for curvature and refraction.

Angle of elevation.	Differences of elevation in feet.																													
′	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
01	.65	1.3	1.9	2.6	3.3	3.9	4.6	5.2	5.9	6.5	7.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
02	.33	.65	.97	1.3	3.6	1.9	2.3	2.6	2.9	3.3	3.6	3.9	4.2	4.6	4.9	5.2	5.5	5.9	6.2	6.5	6.8	.....	.....	.....	.....	.....	.....	.....	.....	.....
03	.22	.43	.65	.86	1.1	1.3	1.5	1.7	1.9	2.2	2.4	2.6	2.8	3.0	3.3	3.5	3.7	3.9	4.1	4.3	4.6	4.8	5.0	5.2	5.4	5.6	5.9	6.1	6.3	6.5
04	.16	.33	.49	.65	.81	.98	1.1	1.3	1.5	1.6	1.8	1.9	2.1	2.3	2.4	2.6	2.8	2.9	3.1	3.3	3.4	3.6	3.7	3.9	4.1	4.2	4.4	4.6	4.7	4.9
05	.13	.26	.39	.52	.65	.78	.91	1.0	1.2	1.3	1.4	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.5	2.6	2.7	2.9	3.0	3.1	3.3	3.4	3.5	3.6	3.8	3.9
06	.11	.22	.33	.43	.54	.65	.76	.87	.98	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.3
07	.09	.19	.28	.37	.47	.56	.65	.74	.84	.93	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8
08	.08	.16	.24	.33	.41	.49	.57	.65	.73	.81	.90	.98	1.1	1.1	1.2	1.3	1.4	1.5	1.6	1.6	1.7	1.8	1.9	1.9	2.0	2.1	2.2	2.3	2.4	2.4
09	.07	.14	.22	.29	.36	.43	.51	.58	.66	.72	.80	.87	.94	1.0	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.7	1.8	1.9	1.9	2.0	2.1	2.2
10	.07	.13	.20	.26	.33	.39	.46	.52	.59	.65	.71	.78	.85	.91	.98	1.0	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.6	1.6	1.7	1.8	1.8	1.9	1.9
11	.06	.12	.18	.24	.29	.36	.41	.47	.53	.59	.65	.71	.77	.83	.89	.95	1.0	1.1	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.5	1.6	1.7	1.7	1.8
12	.05	.11	.16	.22	.27	.33	.38	.43	.49	.54	.60	.65	.71	.76	.81	.87	.92	.98	1.0	1.1	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.5	1.6	1.6
13	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75	.80	.85	.90	.95	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.4	1.5
14	.05	.09	.14	.19	.23	.28	.33	.37	.42	.47	.51	.56	.60	.65	.70	.74	.79	.84	.88	.93	.98	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.3	1.4
15	.04	.09	.13	.17	.22	.26	.30	.35	.39	.43	.48	.52	.56	.61	.65	.69	.74	.78	.83	.87	.91	.96	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3
16	.04	.08	.12	.16	.20	.24	.28	.33	.37	.41	.45	.49	.53	.57	.61	.65	.69	.73	.77	.81	.85	.90	.94	.98	1.0	1.1	1.1	1.1	1.2	1.2
17	.04	.08	.11	.15	.19	.23	.27	.31	.34	.38	.42	.46	.50	.54	.57	.61	.65	.69	.73	.77	.80	.84	.88	.92	.96	1.0	1.0	1.1	1.1	1.2
18	.04	.07	.11	.14	.18	.22	.25	.29	.33	.36	.40	.43	.47	.51	.54	.58	.61	.65	.69	.72	.76	.80	.83	.87	.90	.94	.98	1.0	1.0	1.1
19	.03	.07	.10	.14	.17	.21	.24	.27	.31	.34	.38	.41	.44	.48	.51	.55	.58	.62	.65	.69	.72	.75	.79	.82	.86	.89	.93	.96	.99	1.0
20	.03	.07	.10	.13	.16	.19	.23	.25	.29	.32	.36	.39	.42	.46	.49	.52	.55	.59	.62	.65	.68	.72	.75	.78	.81	.84	.88	.91	.94	.98
21	.03	.06	.09	.12	.16	.19	.21	.25	.28	.31	.34	.37	.40	.43	.47	.50	.53	.56	.59	.62	.65	.68	.71	.74	.78	.81	.84	.87	.90	.93
22	.03	.06	.09	.12	.14	.18	.20	.24	.27	.30	.33	.35	.38	.41	.44	.47	.50	.53	.56	.59	.62	.65	.68	.71	.74	.77	.80	.83	.86	.89
23	.03	.06	.08	.11	.14	.17	.19	.23	.25	.28	.31	.34	.37	.40	.42	.45	.48	.51	.54	.57	.59	.62	.65	.68	.71	.74	.76	.79	.82	.85
24	.03	.05	.08	.11	.14	.16	.19	.22	.25	.27	.30	.33	.35	.38	.41	.43	.46	.49	.52	.54	.57	.60	.62	.65	.68	.71	.73	.76	.79	.81
25	.03	.05	.08	.10	.13	.16	.18	.21	.24	.26	.29	.31	.34	.36	.39	.42	.44	.47	.50	.52	.55	.57	.60	.63	.65	.68	.70	.73	.76	.78
26	.03	.05	.08	.10	.12	.15	.18	.20	.23	.25	.28	.30	.32	.35	.38	.40	.43	.45	.48	.50	.53	.55	.58	.60	.63	.65	.68	.70	.73	.75
27	.02	.05	.07	.10	.12	.14	.17	.19	.22	.24	.27	.28	.31	.34	.36	.39	.41	.43	.46	.48	.51	.53	.55	.58	.60	.63	.65	.68	.70	.72
28	.02	.04	.07	.09	.12	.14	.16	.19	.22	.23	.26	.28	.30	.33	.34	.37	.40	.42	.44	.47	.49	.51	.53	.56	.58	.60	.63	.65	.67	.70
29	.02	.04	.07	.09	.11	.13	.16	.18	.20	.22	.25	.27	.29	.31	.34	.36	.38	.40	.43	.45	.47	.49	.52	.54	.56	.58	.61	.63	.65	.67
30	.02	.04	.07	.09	.11	.13	.15	.17	.20	.22	.24	.26	.28	.30	.33	.35	.37	.39	.41	.43	.46	.48	.50	.52	.54	.56	.59	.61	.63	.65

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile*—Continued.

Angle of Elevation.	Differences of elevation in feet.														
′	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
01	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
02	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
03	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
04	5.0	5.2	5.4	5.5	5.7	5.9	6.0	6.2	6.3	......	......	......	......	......	......
05	4.0	4.2	4.3	4.4	4.6	4.7	4.8	4.9	5.1	......	......	......	......	......	......
06	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.6	4.7	4.8	4.9
07	2.9	3.9	3.1	3.2	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2
08	2.5	2.6	2.7	2.8	2.8	2.9	3.0	3.1	3.2	3.3	3.3	3.4	3.5	3.6	3.7
09	2.2	2.3	2.4	2.5	2.5	2.6	2.7	2.7	2.8	2.9	3.0	3.0	3.1	3.2	3.3
10	2.0	2.1	2.1	2.2	2.3	2.3	2.4	2.5	2.5	2.6	2.7	2.7	2.8	2.9	2.9
11	1.8	1.9	1.9	2.0	2.1	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.5	2.6	2.7
12	1.7	1.7	1.8	1.8	1.9	1.9	2.0	2.1	2.1	2.2	2.2	2.3	2.3	2.4	2.4
13	1.5	1.6	1.6	1.7	1.7	1.8	1.8	1.9	1.9	2.0	2.0	2.1	2.1	2.2	2.2
14	1.4	1.5	1.5	1.6	1.6	1.7	1.7	1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.1
15	1.3	1.4	1.4	1.5	1.5	1.6	1.6	1.6	1.7	1.7	1.8	1.8	1.9	1.9	1.9
16	1.3	1.3	1.3	1.4	1.4	1.5	1.5	1.5	1.6	1.6	1.7	1.7	1.7	1.8	1.8
17	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.5	1.5	1.5	1.6	1.6	1.6	1.7	1.7
18	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.5	1.5	1.5	1.6	1.6	1.6
19	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.5	1.5
20	1.0	1.9	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.5
21	.96	.99	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4
22	.92	.95	.98	1.9	1.0	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3
23	.88	.91	.93	.96	1.9	1.0	1.0	1.1	1.1	1.1	1.1	1.2	1.2	1.3	1.3
24	.84	.87	.90	.92	.95	.98	1.0	1.0	1.1	1.1	1.1	1.1	1.2	1.2	1.2
25	.81	.83	.86	.89	.91	.94	.96	.99	1.0	1.0	1.1	1.1	1.1	1.1	1.2
26	.78	.80	.83	.85	.88	.90	.93	.95	.98	1.0	1.0	1.0	1.1	1.1	1.1
27	.75	.77	.80	.82	.84	.87	.89	.92	.94	.96	.99	1.0	1.0	1.1	1.1
28	.72	.74	.77	.79	.81	.84	.86	.88	.91	.93	.95	.98	1.0	1.0	1.0
29	.70	.72	.74	.76	.79	.81	.83	.85	.88	.90	.92	.94	.97	.99	1.0
30	.67	.69	.72	.74	.76	.78	.80	.82	.85	.87	.89	.91	.93	.96	.98

Angle of Elevation.	Differences of elevation in feet.														
′	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
01	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
02	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
03	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
04	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
05	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
06	5.0	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.9	6.0	6.1	6.2	6.3	6.4	6.5
07	4.3	4.4	4.5	4.6	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6
08	3.7	3.8	3.9	4.0	4.1	4.1	4.2	4.3	4.4	4.5	4.6	4.6	4.7	4.8	4.9
09	3.3	3.4	3.5	3.5	3.6	3.7	3.8	3.8	3.9	4.0	4.9	4.1	4.2	4.3	4.3
10	3.0	3.1	3.1	3.2	3.3	3.3	3.4	3.4	3.5	3.6	3.6	3.7	3.8	3.8	3.9
11	2.7	2.8	2.8	2.9	3.0	3.0	3.1	3.1	3.2	3.3	3.3	3.4	3.4	3.5	3.5
12	2.5	2.5	2.6	2.7	2.7	2.8	2.8	2.9	2.9	3.0	3.0	3.1	3.1	3.2	3.3
13	2.3	2.3	2.4	2.4	2.5	2.5	2.6	2.7	2.7	2.8	2.8	2.9	2.9	2.9	3.0
14	2.1	2.2	2.2	2.3	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.6	2.7	2.7	2.8
15	2.0	2.0	2.1	2.1	2.2	2.2	2.3	2.3	2.3	2.4	2.4	2.5	2.5	2.6	2.6
16	1.9	1.9	1.9	2.0	2.0	2.1	2.1	2.2	2.2	2.2	2.3	2.3	2.4	2.4	2.4
17	1.8	1.8	1.8	1.9	1.9	1.9	2.0	2.9	2.1	2.1	2.1	2.2	2.2	2.3	2.3
18	1.7	1.7	1.7	1.8	1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.1	2.1	2.1	2.2
19	1.6	1.6	1.6	1.7	1.7	1.7	1.8	1.8	1.8	1.9	1.9	1.9	2.0	2.0	2.1
20	1.5	1.5	1.6	1.6	1.6	1.7	1.7	1.7	1.8	1.8	1.8	1.9	1.9	1.9	1.9
21	1.4	1.5	1.5	1.5	1.5	1.6	1.6	1.6	1.7	1.7	1.7	1.8	1.8	1.8	1.9
22	1.4	1.4	1.4	1.4	1.5	1.5	1.5	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.8
23	1.3	1.3	1.4	1.4	1.4	1.4	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.7	1.7
24	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.6	1.6	1.6
25	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.6
26	1.1	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.4	1.5	1.5
27	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.4
28	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.4	1.4
29	1.0	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.3
30	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.3	1.3	1.3

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile*—Continued.

Angle of elevation.	Differences of elevation in feet.																													
′	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	.02	.04	.06	.08	.11	.13	.15	.17	.19	.21	.23	.25	.27	.29	.32	.34	.36	.38	.40	.42	.44	.46	.48	.50	.53	.55	.57	.59	.61	.63
32	.02	.04	.06	.08	.10	.12	.14	.16	.18	.20	.22	.24	.26	.28	.31	.33	.35	.37	.39	.41	.43	.45	.47	.49	.51	.53	.55	.57	.59	.61
33	.02	.04	.06	.08	.10	.12	.14	.16	.18	.20	.22	.24	.26	.28	.30	.32	.34	.36	.37	.39	.41	.43	.45	.47	.49	.51	.53	.55	.57	.59
34	.02	.04	.06	.08	.10	.11	.13	.15	.17	.19	.21	.23	.25	.27	.29	.31	.33	.34	.36	.38	.40	.42	.44	.46	.48	.50	.52	.54	.56	.57
35	.02	.04	.06	.07	.09	.11	.13	.15	.17	.19	.20	.22	.24	.26	.28	.30	.32	.33	.35	.37	.39	.41	.43	.45	.47	.48	.50	.52	.54	.56
36	.02	.04	.05	.07	.09	.11	.13	.14	.16	.18	.20	.22	.24	.25	.27	.29	.31	.33	.34	.36	.38	.40	.42	.43	.45	.47	.49	.51	.52	.54
37	.02	.04	.05	.07	.09	.11	.12	.14	.16	.18	.19	.21	.23	.25	.26	.28	.30	.32	.33	.35	.37	.39	.40	.42	.44	.46	.48	.49	.51	.53
38	.02	.03	.05	.07	.09	.10	.12	.14	.15	.17	.19	.21	.22	.24	.26	.27	.29	.31	.33	.34	.36	.38	.39	.41	.43	.45	.46	.48	.50	.51
39	.02	.03	.05	.07	.08	.10	.12	.13	.15	.17	.18	.20	.22	.23	.25	.27	.28	.30	.32	.33	.35	.37	.38	.40	.42	.43	.45	.48	.48	.50
40	.02	.03	.05	.07	.08	.10	.11	.13	.15	.16	.18	.20	.21	.23	.24	.26	.28	.29	.31	.33	.34	.36	.37	.39	.41	.42	.44	.46	.47	.49
41	.02	.03	.05	.06	.08	.10	.11	.13	.14	.16	.17	.19	.21	.22	.24	.25	.27	.29	.30	.33	.33	.35	.37	.38	.40	.41	.43	.44	.46	.48
42	.02	.03	.05	.06	.08	.09	.11	.12	.14	.16	.17	.19	.20	.22	.23	.25	.26	.28	.29	.31	.33	.34	.36	.37	.39	.40	.42	.43	.45	.47
43	.02	.03	.05	.06	.08	.09	.11	.12	.14	.15	.17	.18	.20	.21	.23	.24	.26	.27	.29	.30	.32	.33	.35	.36	.38	.39	.41	.42	.44	.45
44	.02	.03	.04	.06	.07	.09	.10	.12	.13	.15	.16	.18	.19	.21	.22	.24	.25	.27	.28	.30	.31	.33	.34	.36	.37	.38	.40	.41	.43	.44
45	.01	.03	.04	.06	.07	.09	.10	.12	.13	.14	.16	.17	.19	.20	.22	.23	.25	.26	.27	.29	.30	.32	.33	.35	.36	.38	.39	.41	.42	.43
46	.01	.03	.04	.06	.07	.08	.10	.11	.13	.14	.16	.17	.18	.20	.21	.23	.24	.25	.27	.28	.30	.31	.33	.34	.35	.37	.38	.40	.41	.42
47	.01	.03	.04	.06	.07	.08	.10	.11	.12	.14	.15	.17	.18	.19	.21	.22	.24	.25	.26	.28	.29	.30	.32	.33	.35	.36	.37	.39	.40	.42
48	.01	.03	.04	.05	.07	.08	.09	.11	.12	.14	.15	.16	.18	.19	.20	.22	.23	.24	.26	.27	.28	.30	.31	.33	.34	.35	.37	.38	.39	.41
49	.01	.03	.04	.05	.07	.08	.09	.11	.12	.13	.15	.16	.17	.19	.20	.21	.23	.24	.25	.27	.28	.29	.31	.32	.33	.35	.36	.37	.39	.40
50	.01	.03	.04	.05	.07	.08	.09	.10	.12	.13	.14	.16	.17	.18	.20	.21	.22	.23	.25	.26	.27	.28	.30	.31	.33	.34	.35	.36	.38	.39
51	.01	.03	.04	.05	.06	.08	.09	.10	.11	.13	.14	.15	.17	.18	.19	.20	.22	.23	.24	.26	.27	.28	.29	.31	.32	.33	.34	.36	.37	.38
52	.01	.03	.04	.05	.06	.08	.09	.10	.11	.13	.14	.15	.16	.18	.19	.20	.21	.23	.24	.25	.26	.28	.29	.30	.31	.33	.34	.35	.36	.38
53	.01	.02	.04	.05	.06	.07	.09	.10	.11	.12	.13	.15	.16	.17	.18	.20	.21	.22	.23	.25	.26	.27	.28	.29	.31	.32	.33	.34	.36	.37
54	.01	.02	.04	.05	.06	.07	.08	.10	.11	.12	.13	.14	.16	.17	.18	.19	.21	.22	.23	.24	.25	.27	.28	.29	.30	.31	.33	.34	.35	.36
55	.01	.02	.04	.05	.06	.07	.08	.09	.11	.12	.13	.14	.16	.17	.18	.19	.20	.21	.22	.24	.25	.26	.27	.28	.30	.31	.32	.33	.34	.35
56	.01	.02	.03	.05	.06	.07	.08	.09	.10	.12	.13	.14	.15	.16	.17	.19	.20	.21	.22	.23	.24	.26	.27	.28	.29	.30	.31	.33	.34	.35
57	.01	.02	.03	.05	.06	.07	.08	.09	.10	.11	.13	.14	.15	.16	.17	.18	.19	.21	.22	.23	.24	.25	.26	.27	.29	.30	.31	.32	.33	.34
58	.01	.02	.03	.04	.06	.07	.08	.09	.10	.11	.12	.13	.14	.16	.17	.18	.19	.20	.21	.22	.24	.25	.26	.27	.28	.29	.30	.31	.33	.34
59	.01	.02	.03	.04	.06	.07	.08	.09	.10	.11	.12	.13	.14	.15	.17	.18	.19	.20	.21	.22	.23	.24	.25	.26	.28	.29	.30	.31	.32	.33
1° 0′	.01	.02	.03	.04	.05	.07	.08	.09	.10	.11	.12	.13	.14	.15	.16	.17	.18	.20	.21	.22	.23	.24	.25	.26	.27	.28	.29	.30	.31	.33

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile*—Continued.

Angle of elevation.	Differences of elevation in feet.																													
′	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
31	.65	.67	.69	.71	.74	.76	.77	.80	.82	.84	.86	.88	.90	.92	.95	.97	.99	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.3
32	.63	.65	.67	.69	.71	.73	.75	.77	.79	.81	.83	.85	.88	.90	.92	.94	.96	.98	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2
33	.61	.63	.65	.67	.69	.71	.73	.75	.77	.79	.81	.83	.85	.87	.89	.91	.93	.93	.97	.99	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.2	1.2
34	.59	.61	63	.65	.67	.69	.71	.73	.75	.77	.79	.80	.82	.84	.86	.88	.90	.92	.94	.96	.98	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1
35	.58	.60	.60	.63	.65	.67	.69	.71	.73	.74	·77	.78	.80	.82	.84	.86	.87	.89	.91	.91	.95	.97	.99	1.0	1.0	1.0	1.1	1.1	1.1	1.1
36	.56	.58	.60	.62	.63	.65	.67	.69	.71	.72	.74	.76	.78	.80	.81	.81	.85	.87	.89	.90	.92	.94	.96	.98	1.0	1.0	1.0	1.0	1.1	1.1
37	.55	.56	.58	.60	.62	.63	.65	.67	.69	.70	.72	.74	.76	.77	.79	.81	.83	.84	.86	.88	.90	.92	.93	.95	.97	.99	1.0	1.0	1.0	1.1
38	.53	.55	.57	.58	.60	.62	.63	.65	.67	.69	.70	.72	.74	.75	.77	.79	.81	.82	.84	.86	.87	.89	.91	.92	.94	.96	.98	.99	1.0	1.0
39	.52	.53	.55	.57	.58	.60	.62	.63	.65	.67	.68	.70	.72	.73	.75	.77	.78	.80	.82	.84	.85	.87	.89	.90	.92	.94	.95	.97	.99	1.0
40	.50	.52	.54	.55	.57	.59	.60	.62	.63	.65	.67	.68	.70	.72	.73	.75	.77	.78	.80	.81	.83	.85	.86	.88	.90	.91	.93	.94	.96	.98
41	.49	.51	.52	.54	.56	.57	.59	.60	.62	.64	.65	.67	.68	.70	.71	.73	.75	.76	.78	.79	.81	.83	.84	.86	.87	.89	.91	.92	.94	.95
42	.48	.50	.51	.53	.54	.56	.57	.59	.60	.62	.64	.65	.67	.68	.70	.71	.73	.74	.76	.78	.80	.81	.82	.85	.86	.87	.88	.90	.91	.93
43	.47	.48	.50	.51	.53	.55	.56	.58	.59	.61	.62	.64	.65	.67	.68	.70	.71	.73	.74	.76	.77	.79	.80	.82	.83	.85	.86	.89	.89	.91
44	.46	.47	.49	.50	.52	.53	.55	.56	.58	.59	.61	.62	.64	.65	.67	.68	.70	.71	.73	.74	.75	.77	.78	.80	.81	.83	.84	.86	.87	.89
45	.45	.46	.48	.49	.51	.52	.54	.55	.56	.58	.59	.61	.62	.64	.65	.67	.68	.69	.71	.72	.74	.75	.77	.78	.80	.81	.83	.84	.85	.87
46	.44	.45	.47	.48	.50	.51	.52	.54	.55	.57	.58	.59	.61	.62	.64	.65	.67	.68	.69	.71	.72	.74	.75	.76	.78	.79	.81	.82	.84	.85
47	.43	.44	.46	.47	.48	.50	.51	.53	.54	.55	.57	.58	.60	.61	.62	.64	.65	.66	.68	.69	.71	,72	.73	.75	.76	.78	.79	.80	.82	.83
48	.42	.43	.45	.46	.47	.49	.50	.52	.53	.54	.56	.57	.58	.60	.61	.62	.64	.65	.66	.68	.69	.71	.72	.73	.75	.76	.77	.79	.80	.81
49	.41	.43	.44	.45	.47	.48	.49	.50	.52	.53	.54	.56	.57	.58	.60	.61	.62	.64	.65	.66	.68	.69	.70	.72	.73	.74	.76	.77	.78	.80
50	.40	.42	.43	.44	.46	.47	.48	.49	.51	.52	.53	.55	.56	.57	.59	.60	.61	.63	.64	.65	.66	.68	.69	.70	.72	.74	.74	.76	.77	.78
51	.40	.41	.42	.43	.45	.46	.47	.49	.50	.51	.52	.54	.55	.56	.57	.59	.60	.61	.63	.64	.65	.66	.68	.69	.70	.72	.73	.74	.75	.77
52	.39	.40	.41	.43	.44	.45	.46	.48	.49	.50	.51	.53	.54	.55	.56	.58	.59	.60	.61	.63	.64	.65	.66	.68	.69	.70	.71	.73	.74	.75
53	.38	.39	.41	.42	.43	.44	.45	.47	.48	.49	.50	.52	.53	.54	.55	.57	.58	.59	.60	.61	.63	.64	.65	.66	.68	.69	.70	.71	.72	.74
54	.37	.39	.40	.41	.42	.43	.45	.46	.47	.48	.49	.51	.52	.53	.54	.55	.57	.59	.59	.60	.61	.63	.64	.65	.66	.68	.69	.70	.71	.72
55	.37	.38	.40	.40	.41	.43	.44	.45	.46	.47	.49	.50	.51	.52	.53	.54	.56	.57	.58	.59	.60	.62	.63	.64	.65	.66	.67	.69	.70	.71
56	.36	.37	.38	.40	.41	.42	.43	.44	.45	.47	.48	.49	.50	.51	.52	.53	.55	.56	.57	.58	.59	.60	.62	.63	.64	.65	.66	.67	.69	.70
57	.35	.37	.38	.39	.40	.41	.42	.43	.45	.46	.47	.48	.49	.50	.51	.53	.54	.55	.56	.57	.58	.59	.61	.62	.63	.64	.65	.66	.67	.69
58	.35	.36	.37	.38	.39	.40	.42	.43	.44	.45	.46	.47	.48	.49	.51	.52	.53	.54	.55	.56	.57	.58	.60	.61	.62	.63	.64	.65	.66	.67
59	.34	.35	.36	.38	.39	.40	.41	.42	.43	.44	.45	.46	.47	.49	.50	.51	.52	.53	.54	.55	.56	.57	.59	.60	.61	.62	.63	.64	.65	.66
1°00′	.34	.35	.36	.37	.38	.39	.40	.41	.42	.43	.44	.46	.47	.48	.49	.50	.51	.52	.53	.54	.54	.56	.58	.59	.60	.61	.62	.63	.64	.65

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile*—Continued.

Angle of elevation.	Differences of elevation in feet.																													
′	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
31	1.3	1.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
32	1.2	1.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
33	1.2	1.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
34	1.2	1.2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
35	1.1	1.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
36	1.1	1.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
37	1.1	1.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
38	1.0	1.1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
39	1.0	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
40	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
41	.97	.98	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
42	.95	.96	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
43	.92	.94	.95	.97	.98	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
44	.90	.92	.93	.95	.96	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
45	.88	.90	.91	.93	.94	.95	.97	.98	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
46	.86	.88	.89	.91	.92	.93	.95	.96	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
47	.84	.86	.87	.89	.90	.91	.93	.94	.96	.97	.98	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....								
48	.83	.84	.85	.87	.88	.90	.91	.92	.94	.95	.96	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....								
49	.81	.82	.84	.85	.86	.88	.89	.90	.92	.93	.94	.96	.97	.98	1.0	.....	.....	.....	.....	.....	.....	.....								
50	.79	.80	.82	.84	.85	.86	.87	.89	.90	.91	.93	.94	.95	.96	.98	.99	1.0	.....	.....	.....	.....	.....								
51	.78	.79	.80	.82	.83	.84	.86	.87	.88	.89	.91	.92	.93	.94	.96	.97	.98	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
52	.77	.78	.79	.80	.81	.83	.84	.85	.86	.87	.89	.90	.91	.92	.94	.95	.96	.97	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
53	.75	.76	.77	.79	.80	.81	.83	.84	.85	.86	.87	.88	.90	.91	.92	.93	.95	.96	.97	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....
54	.74	.75	.76	.77	.78	.79	.81	.82	.83	.84	.86	.87	.88	.90	.90	.92	.93	.94	.95	.96	.98	.99	.99	1.0	.....	.....	.....	.....	.....	.....
55	.72	.73	.75	.76	.77	.78	.79	.80	.82	.83	.84	.85	.86	.88	.89	.90	.91	.92	.94	.95	.96	.97	.98	.99	1.0	.....	.....	.....	.....	.....
56	.71	.72	.73	.74	.76	.77	.78	.79	.80	.81	.83	.84	.85	.86	.87	.88	.90	.91	.92	.93	.94	.95	.97	.98	.99	1.0	.....	.....	.....	.....
57	.70	.71	.72	.73	.75	.76	.77	.78	.79	.80	.82	.83	.84	.85	.86	.87	.89	.90	.91	.92	.93	.94	.96	.97	.98	.99	1.0	.....	.....	.....
58	.68	.70	.71	.72	.73	.74	.75	.76	.77	.79	.80	.81	.82	.83	.84	.85	.86	.88	.89	.90	.91	.92	.93	.94	.95	.97	.98	.99	1.0	.....
59	.67	.68	.70	.71	.72	.73	.74	.75	.76	.77	.78	.79	.81	.82	.83	.84	.85	.86	.87	.88	.89	.90	.92	.93	.94	.95	.96	.97	.98	.99
1° 00′	.66	.67	.68	.69	.71	.72	.73	.74	.75	.76	.77	.78	.79	.80	.81	.82	.84	.85	.86	.87	.88	.89	.90	.91	.92	.93	.94	.95	.97	.98

Angle of elevation.	Differences of elevation in feet.	
′	91	92
59	1.0	.....
1° 00′	.99	1.0

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile*—Continued.

Angle of elevation.	Differences of elevation in feet.																													
° ′	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1° 01′	.01	.02	.03	.04	.05	.06	.07	.09	.10	.11	.12	.13	.14	.15	.16	.17	.18	.19	.20	.21	.22	.23	.25	.26	.27	.28	.29	.30	.31	.32
02	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	.11	.13	.14	.15	.16	.17	.18	.19	.20	.21	.22	.23	.24	.25	.26	.27	.28	.29	.30	.32
03	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	.11	.12	.13	.14	.16	.17	.18	.19	.20	.21	.22	.23	.24	.25	.26	.27	.28	.29	.30	.31
04	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	.11	.12	.13	.14	.15	.16	.17	.18	.19	.20	.21	.22	.23	.24	.25	.26	.27	.28	.29	.31
1° 05′	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	.11	.12	.13	.14	.15	.16	.17	.18	.19	.20	.21	.22	.23	.24	.25	.26	.27	.28	.29	.30
06	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	.11	.12	.13	.14	.15	.16	.17	.18	.19	.20	.21	.22	.23	.24	.25	.26	.27	.28	.29	.30
07	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	.11	.12	.13	.14	.15	.16	.17	.17	.18	.19	.20	.21	.22	.23	.24	.25	.26	.27	.28	.29
08	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	.11	.11	.12	.13	.14	.15	.16	.17	.18	.19	.20	.21	.22	.23	.24	.25	.26	.27	.28	.29
09	.01	.02	.03	.04	.05	.06	.07	.08	.08	.09	.10	.11	.12	.13	.14	.15	.16	.17	.18	.19	.20	.21	.22	.23	.24	.25	.25	.26	.27	.28
1° 10′	.01	.02	.03	.04	.05	.06	.07	.07	.08	.09	.10	.11	.12	.13	.14	.15	.16	.17	.18	.19	.20	.20	.21	.22	.23	.24	.25	.26	.27	.28
11	01	.02	.03	.04	.05	.06	.06	.07	.08	.09	.10	.11	.12	.13	.14	.15	.16	.17	.17	.18	.19	.20	.21	.22	.23	.24	.25	.26	.27	.28
12	.01	.02	.03	.04	.05	.05	.06	.07	.08	.09	.10	.11	.12	.13	.14	.14	.15	.16	.17	.18	.19	.20	.21	.22	.23	.24	.24	.25	.26	.27
13	.01	.02	.03	.04	.04	.05	.06	.07	.08	.09	.10	.11	.12	.12	.13	.14	.15	.16	.17	.18	.19	.20	.21	.21	.22	.23	.24	.25	.26	.27
14	.01	.02	.03	.04	.04	.05	.06	.07	.08	.09	.10	.11	.11	.12	.13	.14	.15	.16	.17	.18	.18	.19	.20	.21	.22	.23	.24	.25	.26	.20
1° 15′	.01	.02	.03	.03	.04	.05	.06	.07	.08	.09	.10	.10	.11	.12	.13	.14	.15	.16	.16	.17	.18	.19	.20	.21	.22	.23	.23	.24	.25	.26
16	.01	.02	.03	.03	.04	.05	.06	.07	.08	.09	.09	.10	.11	.12	.13	.14	.15	.15	.16	.17	.18	.19	.20	.21	.21	.22	.23	.24	.25	.26
17	.01	.02	.03	.03	.04	.05	.06	.07	.08	.08	.09	.10	.11	.12	.13	.14	.14	.15	16	.17	.18	.19	.19	.20	.21	.22	.23	.24	.25	.25
18	.01	.02	.03	.03	.04	.05	.06	.07	.08	.08	.09	.10	.11	.12	.13	.13	.14	.15	.16	.17	.18	.18	.19	.20	.21	.22	.23	.23	.24	.25
19	.01	.02	.02	.03	.04	.05	.06	.07	.07	.08	.09	.10	.11	.12	.12	.13	.14	.15	.16	.16	.17	.18	.19	.20	.21	.21	.22	.23	.24	.25
1° 20′	.01	.02	.02	.03	.04	.05	.06	.07	.07	.08	.09	.10	.11	.11	.12	.13	.14	.15	.15	.16	.17	.18	.19	.20	.20	.21	.22	.23	.24	.24
21	.01	.02	.02	.03	.04	.05	.06	.06	.07	.08	.09	.10	.10	.11	.12	.13	.14	.14	.15	.16	.17	.18	.18	.19	.20	.21	.22	.23	.23	.24
22	.01	.02	.02	.03	.04	.05	.06	.06	.07	.08	.09	.10	.10	.11	.12	.13	.13	.14	.15	.16	.17	.17	.18	.19	.20	.21	.21	.22	.23	.24
23	.01	.02	.02	.03	.04	.05	.05	.06	.07	.08	.09	.09	.10	.11	.12	.13	.13	.14	.15	.16	.16	.17	.18	.19	.20	.20	.21	.22	.23	.24
24	.01	.02	.02	.03	.04	.05	.05	.06	.07	.08	.09	.09	.10	.11	.12	.12	.13	.14	.15	.16	.16	.17	.18	.19	.19	.20	.21	.22	.23	.23
1° 25′	.01	.02	.02	.03	.04	.05	.05	.06	.07	.08	.08	.09	.10	.11	.11	.12	.13	.14	.15	.15	.16	.17	.18	.18	.19	.20	.21	.21	.22	.23
26	.01	.02	.02	.03	.04	.05	.05	.06	.07	.08	.08	.09	.10	.11	.11	.12	.13	.14	.15	.15	.16	.17	.17	.18	.19	.20	.20	.21	.22	.23
27	.01	.01	.02	.03	.04	.04	.05	.06	.07	.07	.08	.09	.10	.10	.11	.12	.13	.13	.14	.15	.16	.16	.17	.18	.19	.19	.20	.21	.22	.22
28	.01	.01	.02	.03	.04	.04	.05	.06	.07	.07	.08	.09	.10	.10	.11	.12	.13	.13	.14	.15	.16	.16	.17	.18	.18	.19	.20	.21	.21	.22
29	.01	.01	.02	.03	.04	.04	.05	.06	.07	.07	.08	.09	.10	.10	.11	.12	.12	.13	.14	.15	.15	.16	.17	.18	.18	.19	.20	.20	.21	.22
1° 30′	.01	.01	.02	.03	.04	.04	.05	.06	.07	.07	.08	.09	.09	.10	.11	.12	.12	.13	.14	.14	.15	.16	.17	.17	.18	.19	.20	.20	.21	.22

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile*—Continued.

Angle of elevation.	Differences of elevation in feet.																													
° ′	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
1° 01′	.33	.34	.35	.36	.37	.38	.39	.41	.42	.43	.44	.45	.46	.47	.48	.49	.50	.51	.52	.53	.54	.55	.57	.58	.59	.60	.61	.62	.63	.64
02	.33	.34	.35	.36	.37	.38	.39	.40	.41	.42	.43	.44	.45	.46	.47	.48	.49	.50	.51	.53	.54	.55	.56	.57	.58	.59	.60	.61	.62	.63
03	.32	.33	.34	.35	.36	.37	.38	.39	.40	.41	.42	.43	.44	.45	.47	.48	.49	.50	.51	.52	.53	.54	.55	.56	.57	.58	.59	.60	.61	.62
04	.32	.33	.34	.35	.36	.37	.38	.39	.40	.41	.42	.43	.44	.45	.46	.47	.48	.49	.50	.51	.52	.53	.54	.55	.56	.57	.58	.59	.60	.61
1° 05′	.31	.32	.33	.34	.35	.36	.37	.38	.39	.40	.41	.42	.43	.44	.45	.46	.47	.48	.49	.50	.51	.52	.53	.54	.55	.56	.57	.58	.59	.60
06	.31	.32	.33	.34	.35	.36	.37	.37	.38	.39	.40	.41	.42	.43	.44	.45	.46	.47	.48	.49	.50	.51	.52	.53	.54	.55	.56	.57	.58	.59
07	.30	.31	.32	.33	.34	.35	.36	.37	.38	.39	.40	.41	.42	.43	.43	.45	.46	.47	.48	.49	.50	.51	.52	.52	.53	.54	.55	.56	.57	.58
08	.30	.31	.32	.33	.34	.34	.35	.36	.37	.38	.39	.40	.41	.42	.43	.44	.45	.46	.47	.48	.49	.50	.51	.52	.53	.54	.55	.56	.56	.57
09	.29	.30	.31	.32	.33	.34	.35	.36	.37	.38	.39	.40	.41	.42	.42	.43	.44	.45	.46	.47	.48	.49	.50	.51	.52	.53	.54	.55	.56	.57
1° 10′	.29	.30	.31	.32	.33	.33	.34	.35	.36	.37	.38	.39	.40	.41	.42	.43	.44	.45	.46	.47	.47	.48	.49	.50	.51	.52	.53	.54	.55	.56
11	.28	.29	.30	.31	.32	.33	.34	.35	.36	.37	.38	.39	.39	.40	.41	.42	.43	.44	.45	.46	.47	.48	.49	.50	.50	.51	.52	.53	.54	.55
12	.28	.29	.30	.31	.32	.33	.33	.34	.35	.36	.37	.38	.39	.40	.41	.42	.42	.43	.44	.45	.46	.47	.48	.49	.50	.51	.52	.52	.53	.54
13	.28	.29	.29	.30	.31	.32	.33	.34	.35	.36	.37	.37	.38	.39	.40	.41	.42	.43	.44	.45	.45	.46	.47	.48	.49	.50	.51	.52	.53	.53
14	.27	.28	.29	.30	.31	.32	.33	.33	.34	.35	.36	.37	.38	.39	.40	.40	.41	.42	.43	.44	.45	.46	.47	.48	.48	.49	.50	.51	.52	.53
1° 15′	.27	.28	.29	.30	.30	.31	.32	.33	.34	.35	.36	.36	.37	.38	.39	.40	.41	.42	.43	.43	.44	.45	.46	.47	.48	.49	.49	.50	.51	.52
16	.27	.27	.28	.29	.30	.31	.32	.33	.33	.34	.35	.36	.37	.38	.39	.39	.40	.41	.42	.43	.44	.45	.45	.46	.47	.48	.49	.50	.51	.51
17	.26	.27	.28	.29	.30	.30	.31	.32	.33	.34	.35	.36	.36	.37	.38	.39	.40	.41	.41	.42	.43	.44	.45	.46	.47	.47	.48	.49	.50	.51
18	.26	.27	.28	.28	.29	.30	.31	.32	.33	.33	.34	.35	.36	.37	.38	.38	.39	.40	.41	.42	.43	.43	.44	.45	.46	.47	.48	.48	.49	.50
19	.26	.26	.27	.28	.29	.30	.30	.31	.32	.33	.34	.35	.35	.36	.37	.38	.39	.40	.40	.41	.42	.43	.44	.45	.45	.46	.47	.48	.49	.49
1° 20′	.25	.26	.27	.28	.28	.29	.30	.31	.32	.33	.33	.34	.35	.36	.37	.37	.38	.39	.40	.41	.41	.42	.43	.44	.45	.46	.46	.47	.48	.49
21	.25	.26	.27	.27	.28	.29	.30	.31	.31	.32	.33	.34	.35	.35	.36	.37	.38	.39	.39	.40	.41	.42	.43	.43	.44	.45	.46	.47	.47	.48
22	.25	.25	.26	.27	.28	.29	.29	.30	.31	.32	.33	.33	.34	.35	.36	.37	.37	.38	.39	.40	.40	.41	.42	.43	.44	.44	.45	.46	.47	.48
23	.24	.25	.26	.27	.27	.28	.29	.30	.31	.31	.32	.33	.34	.35	.35	.36	.37	.38	.38	.39	.40	.41	.42	.42	.43	.44	.45	.45	.46	.47
24	.24	.25	.26	.26	.27	.28	.29	.29	.30	.31	.32	.33	.33	.34	.35	.36	.36	.37	.38	.39	.40	.40	.41	.42	.43	.43	.44	.45	.46	.47
1° 25′	.24	.25	.25	.26	.27	.28	.28	.29	.30	.31	.31	.32	.33	.34	.34	.35	.36	.37	.38	.38	.39	.40	.41	.41	.42	.43	.44	.44	.45	.46
26	.23	.24	.25	.26	.26	.27	.28	.29	.30	.30	.31	.32	.33	.33	.34	.35	.36	.36	.37	.38	.39	.39	.40	.41	.42	.42	.43	.44	.45	.45
27	.23	.24	.25	.25	.26	.27	.28	.28	.29	.30	.31	.31	.32	.33	.34	.34	.35	.36	.37	.37	.38	.39	.40	.40	.41	.42	.43	.43	.44	.45
28	.23	.24	.24	.25	.26	.27	.27	.28	.29	.30	.30	.31	.32	.33	.33	.34	.35	.36	.36	.37	.38	.38	.39	.40	.41	.41	.42	.43	.44	.44
29	.23	.23	.24	.25	.26	.26	.27	.28	.29	.29	.30	.31	.31	.32	.33	.34	.34	.35	.36	.37	.37	.38	.39	.39	.40	.41	.42	.42	.43	.44
1° 30′	.22	.23	.24	.25	.25	.26	.27	.28	.28	.29	.30	.30	.31	.32	.33	.33	.34	.35	.35	.36	.37	.38	.38	.39	.40	.41	.41	.42	.43	.43

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile*—Continued.

Angle of elevation.	Differences of elevation in feet.																													
° ′	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
1° 01′	.65	.66	.67	.68	.69	.70	.72	.73	.74	.75	.76	.77	.78	.79	.80	.81	.82	.83	.84	.85	.86	.88	.89	.90	.91	.92	.93	.94	.95	.96
02	.64	.65	.66	.67	.68	.69	.70	.71	.72	.74	.75	.76	.77	.78	.79	.80	.81	.82	.83	.84	.85	.86	.87	.88	.89	.90	.91	.92	.93	.95
03	.63	.64	.65	.66	.67	.68	.69	.70	.71	.72	.73	.74	.75	.76	.78	.79	.80	.81	.82	.83	.84	.85	.86	.87	.88	.89	.90	.91	.92	.93
04	.62	.63	.64	.65	.66	.67	.68	.69	.70	.71	.72	.73	.74	.75	.76	.77	.78	.79	.80	.81	.82	.83	.84	.85	.86	.87	.88	.90	.91	.92
1° 05′	.61	.62	.63	.64	.65	.66	.67	.68	.69	.70	.71	.72	.73	.74	.75	.76	.77	.78	.79	.80	.81	.82	.83	.84	.85	.86	.87	.88	.89	.90
06	.60	.61	.62	.63	.64	.65	.66	.67	.68	.69	.70	.71	.72	.73	.74	.75	.76	.77	.78	.79	.80	.81	.82	.83	.84	.85	.86	.87	.88	.89
07	.59	.60	.61	.62	.63	.64	.65	.66	.67	.68	.69	.70	.71	.72	.73	.74	.75	.76	.77	.78	.79	.80	.81	.82	.83	.84	.85	.86	.86	.87
08	.58	.59	.60	.61	.62	.63	.64	.65	.66	.67	.68	.69	.70	.71	.72	.73	.74	.75	.76	.77	.78	.79	.79	.80	.81	.82	.83	.84	.85	.86
09	.58	.58	.59	.60	.61	.62	.63	.64	.65	.66	.67	.68	.69	.70	.71	.72	.73	.74	.75	.75	.76	.77	.78	.79	.80	.81	.82	.83	.84	.85
1° 10′	.57	.58	.59	.60	.60	.61	.62	.63	.64	.65	.66	.67	.68	.69	.70	.71	.72	.73	.73	.74	.75	.76	.77	.78	.79	.80	.81	.82	.83	.84
11	.56	.57	.58	.59	.60	.61	.61	.62	.63	.64	.65	.66	.67	.68	.69	.70	.71	.72	.72	.73	.74	.75	.76	.77	.78	.79	.80	.81	.82	.83
12	.55	.56	.57	.58	.59	.60	.61	.61	.62	.63	.64	.65	.66	.67	.68	.69	.70	.71	.71	.72	.73	.74	.75	.76	.77	.78	.79	.80	.80	.81
13	.54	.55	.56	.57	.58	.59	.60	.61	.62	.62	.63	.64	.65	.66	.67	.68	.69	.70	.70	.71	.72	.73	.74	.75	.76	.77	.78	.78	.79	.80
14	.54	.55	.55	.56	.57	.58	.59	.60	.61	.62	.62	.63	.64	.65	.66	.67	.68	.69	.69	.70	.71	.72	.73	.74	.75	.76	.77	.77	.78	.79
1° 15′	.53	.54	.55	.56	.56	.57	.58	.59	.60	.61	.62	.62	.63	.64	.65	.66	.67	.68	.69	.69	.70	.71	.72	.73	.74	.75	.76	.76	.77	.78
16	.52	.53	.54	.55	.56	.57	.57	.58	.59	.60	.61	.62	.63	.63	.64	.65	.66	.67	.68	.69	.69	.70	.71	.72	.73	.74	.75	.75	.76	.77
17	.52	.53	.53	.54	.55	.56	.57	.57	.58	.59	.60	.61	.62	.63	.63	.64	.65	.66	.67	.68	.68	.69	.70	.71	.72	.73	.74	.74	.75	.76
18	.51	.52	.53	.53	.54	.55	.56	.57	.58	.58	.59	.60	.61	.62	.63	.63	.64	.65	.66	.67	.68	.68	.69	.70	.71	.72	.73	.73	.74	.75
19	.50	.51	.52	.53	.54	.54	.55	.56	.57	.58	.59	.59	.60	.61	.62	.63	.63	.64	.65	.66	.67	.68	.68	.69	.70	.71	.72	.73	.73	.74
1° 20′	.50	.50	.51	.52	.53	.54	.55	.55	.56	.57	.58	.59	.59	.60	.61	.62	.63	.63	.64	.65	.66	.67	.68	.68	.69	.70	.71	.72	.72	.73
21	.49	.50	.51	.51	.52	.53	.54	.55	.55	.56	.57	.58	.59	.59	.60	.61	.62	.63	.63	.64	.65	.66	.67	.68	.68	.69	.70	.71	.72	.72
22	.48	.49	.50	.51	.52	.52	.53	.54	.55	.56	.56	.57	.58	.59	.60	.60	.61	.62	.63	.64	.64	.65	.66	.67	.67	.68	.69	.70	.71	.71
23	.48	.49	.49	.50	.51	.52	.53	.53	.54	.55	.56	.56	.57	.58	.59	.60	.60	.61	.62	.63	.64	.64	.65	.66	.67	.67	.68	.69	.70	.71
24	.47	.48	.49	.50	.50	.51	.52	.53	.53	.54	.55	.56	.57	.57	.58	.59	.60	.60	.61	.62	.63	.64	.64	.65	.66	.67	.67	.68	.69	.70
1° 25′	.47	.47	.48	.49	.50	.51	.51	.52	.53	.54	.54	.55	.56	.57	.57	.58	.59	.60	.60	.61	.62	.63	.64	.64	.65	.66	.67	.67	.68	.69
26	.46	.47	.48	.48	.49	.50	.51	.51	.52	.53	.54	.54	.55	.56	.57	.58	.58	.59	.60	.61	.61	.62	.63	.64	.64	.65	.66	.67	.67	.68
27	.46	.46	.47	.48	.49	.49	.50	.51	.52	.52	.53	.54	.55	.55	.56	.57	.58	.58	.59	.60	.61	.61	.62	.63	.64	.64	.65	.66	.67	.67
28	.45	.46	.47	.47	.48	.49	.50	.50	.51	.52	.53	.53	.54	.55	.55	.56	.57	.58	.58	.59	.60	.61	.61	.62	.63	.64	.64	.65	.66	.67
29	.45	.45	.46	.47	.48	.48	.49	.50	.50	.51	.52	.53	.53	.54	.55	.56	.56	.57	.58	.59	.59	.60	.61	.61	.62	.63	.64	.64	.65	.66
1° 30′	.44	.45	.45	.46	.47	.48	.48	.49	.50	.51	.51	.52	.53	.54	.54	.55	.56	.56	.57	.58	.59	.59	.60	.61	.62	.62	.63	.64	.64	.65

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile*—Continued.

Angle of elevation.	Differences of elevation in feet.																													
° ′	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
1° 01′	.97	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
02	.96	.97	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
03	.94	.95	.96	.97	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
04	.93	.94	.95	.96	.97	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1° 05′	.91	.92	.93	.94	.95	.96	.97	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
06	.90	.91	.92	.93	.94	.95	.96	.97	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
07	.88	.89	.90	.91	.92	.93	.94	.95	.96	.97	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
08	.87	.88	.89	.90	.91	.92	.93	.94	.95	.96	.97	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
09	.86	.87	.88	.89	.90	.91	.92	.92	.93	.94	.95	.96	.97	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1° 10′	.85	.86	.86	.87	.88	.89	.90	.91	.92	.93	.94	.95	.96	.97	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
11	.83	.84	.85	.86	.87	.88	.89	.90	.91	.92	.93	.94	.94	.95	.96	.97	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	.82	.83	84	.85	.86	.87	.88	.89	.90	.90	.91	.92	.93	.94	.95	.96	.97	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
13	.81	.82	.83	.84	.85	.86	.86	.87	.88	.89	.90	.91	.92	.93	.94	.94	.95	.96	.97	.98	.99	1.0	.....	.....	.....	.....	.....	.....	.....	.....
14	.80	.81	.82	.83	.84	.84	.85	.86	.87	.88	.89	.90	.91	.91	.92	.93	.94	.95	.96	.97	.98	.99	.99	1.0	.....	.....	.....	.....	.....	.....
1° 15′	.79	.80	.81	.82	.82	.83	.84	.85	.86	.87	.88	.88	.89	.90	.91	.92	.93	.94	.95	.95	.96	.97	.98	.99	1.0	.....	.....	.....	.....	.....
16	.78	.79	.80	.81	.81	.82	.83	.84	.85	.86	.87	.87	.88	.89	.90	.91	.92	.93	.93	.94	.95	.96	.97	.98	.98	.99	1.0	.....	.....	.....
17	.77	.78	.79	.79	.80	.81	.82	.83	.84	.85	.85	.86	.87	.88	.89	.90	.90	.91	.92	.93	.94	.95	.96	.96	.97	.98	.99	1.0	.....	.....
18	.76	.77	.78	.78	.79	.80	.81	.82	.83	.83	.84	.85	.86	.87	.88	.88	.89	.90	.91	.92	.93	.93	.94	.95	.96	.97	.98	.98	.99	1.0
19	.75	.76	.77	.77	.78	.79	.80	.81	.82	.82	.83	.84	.85	.86	.87	.87	.88	.89	.90	.91	.91	.92	.93	.94	.95	.96	.96	.97	.98	.99
1° 20′	.74	.75	.76	.76	.77	.78	.79	.80	.81	.81	.82	.83	.84	.85	.85	.86	.87	.88	.89	.90	.90	.91	.92	.93	.94	.94	.95	.96	.97	.98
21	.73	.74	.75	.76	.76	.77	.78	.79	.80	.80	.81	.82	.83	.84	.84	.85	.86	.87	.88	.88	.89	.90	.91	.92	.92	.93	.94	.95	.96	.96
22	.72	.73	.74	.75	.75	.76	.77	.78	.79	.79	.80	.81	.82	.83	.83	.84	.85	.86	.87	.87	.88	.89	.90	.91	.91	.92	.93	.94	.94	.95
23	.71	.72	.73	.74	.75	.75	.76	.77	.78	.78	.79	.80	.81	.82	.82	.83	.84	.85	.85	.86	.87	.88	.89	.89	.90	.91	.92	.93	.93	.94
24	.71	.71	.72	.73	.74	.74	.75	.76	.77	.78	.78	.79	.80	.81	.81	.82	.83	.84	.84	.85	.86	.87	.88	.88	.89	.90	.91	.91	.92	.93
1° 25	.70	.70	.71	.72	.73	.74	.74	.75	.76	.77	.77	.78	.79	.80	.80	.81	.82	.83	.83	.84	.85	.86	.87	.87	.88	.89	.90	.90	.91	.92
26	.69	.70	.70	.71	.72	.73	.73	.74	.75	.76	.76	.77	.78	.79	.80	.80	.81	.82	.83	.83	.84	.85	.86	.86	.87	.88	.89	.89	.90	.91
27	.68	.69	.70	.70	.71	.72	.73	.73	.74	.75	.76	.76	.77	.78	.79	.79	.80	.81	.82	.82	.83	.84	.85	.85	.86	.87	.88	.88	.89	.90
28	.67	.68	.69	.70	.70	.71	.72	.72	.73	.74	.75	.75	.76	.77	.78	.78	.79	.80	.81	.81	.82	.83	.84	.84	.85	.86	.87	.87	.88	.89
29	.67	.67	.68	.69	.69	.70	.71	.72	.72	.73	.74	.75	.75	.76	.77	.78	.78	.79	.80	.80	.81	.82	.83	.83	.84	.85	.86	.86	.87	.88
1° 30	.66	.66	.67	.68	.69	.70	.70	.71	.72	.72	.73	.74	.75	.75	.76	.77	.77	.78	.79	.80	.80	.81	.82	.82	.83	.84	.85	.85	.86	.87

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile*—Continued.

Angle of elevation.	Differences of elevation in feet.																	
° ′	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138
1° 01′	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
02	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
03	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
04	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1° 05′	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
06	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
07	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
08	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
09	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1° 10′	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
11	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
12	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
13	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
14	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1° 15′	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
16	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
17	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
18	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
19	**1. 0**	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1° 20′	.98	.99	**1. 0**	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
21	.97	.98	.99	**1. 0**	......	......	......	......	......	......	......	......	......	......	......	......	......	......
22	.96	.97	.98	.98	.99	**1. 0**	......	......	......	......	......	......	......	......	......	......	......	......
23	.95	.96	.96	.97	.98	.99	**1. 0**	......	......	......	......	......	......	......	......	......	......	......
24	.94	.95	.95	.96	.97	.98	.98	.99	**1. 0**	......	......	......	......	......	......	......	......	......
1° 25′	.93	.93	.94	.95	.96	.96	.97	.98	.99	**1. 0**	......	......	......	......	......	......	......	......
26	.92	.92	.93	.94	.95	.95	.96	.97	.98	.98	.99	**1. 0**	......	......	......	......	......	......
27	.91	.91	.92	.93	.94	.94	.95	.96	.97	.97	.98	.99	**1. 0**	......	......	......	......	......
28	.90	.90	.91	.92	.92	.93	.94	.95	.95	.96	.97	.98	.98	.99	**1. 0**	......	......	......
29	.88	.89	.90	.91	.91	.92	.93	.94	.94	.95	.96	.97	.97	.98	.99	.99	**1. 0**	......
1° 30′	.87	.88	.89	.90	.90	.91	.92	.93	.93	.94	.95	.95	.96	.97	.98	.98	.99	**1. 0**

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile*—Continued.

Angle of elevation.	Differences of elevation in feet.																													
° ′	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1° 31′	.01	.01	.02	.03	.04	.04	.05	.06	.06	.07	.08	.09	.09	.10	.11	.11	.12	.13	.14	.14	.15	.16	.10	.17	.18	.19	.19	.20	.21	.22
32	.01	.01	.02	.03	.04	.04	.05	.06	.06	.07	.08	.09	.09	.10	.11	.11	.12	.13	.13	.14	.15	.16	.16	.17	.18	.18	.19	.20	.21	.21
33	.01	.01	.02	.03	.04	.04	.05	.06	.06	.07	.08	.08	.09	.10	.11	.11	.12	.13	.13	.14	.15	.15	.16	.17	.18	.18	.19	.20	.20	.21
34	.01	.01	.02	.03	.04	.04	.05	.06	.06	.07	.08	.08	.09	.10	.10	.11	.12	.13	.13	.14	.15	.15	.16	.17	.17	.18	.19	.19	.20	.21
1° 35′	.01	.01	.02	.03	.03	.04	.05	.06	.06	.07	.08	.08	.09	.10	.10	.11	.12	.12	.13	.14	.14	.15	.16	.16	.17	.18	.19	.19	.20	.21
36	.01	.01	.02	.03	.03	.04	.05	.05	.06	.07	.07	.08	.09	.10	.10	.11	.12	.12	.13	.14	.14	.15	.16	.16	.17	.18	.18	.19	.20	.20
37	.01	.01	.02	.03	.03	.04	.05	.05	.06	.07	.07	.08	.09	.09	.10	.11	.11	.12	.13	.13	.14	.15	.15	.16	.17	.17	.18	.19	.20	.20
38	.01	.01	.02	.03	.03	.04	.05	.05	.06	.07	.07	.08	.09	.09	.10	.11	.11	.12	.13	.13	.14	.15	.15	.16	.17	.17	.18	.19	.19	.20
39	.01	.01	.02	.03	.03	.04	.05	.05	.06	.07	.07	.08	.09	.09	.10	.11	.11	.12	.13	.13	.14	.15	.15	.16	.16	.17	.18	.18	.19	.20
1° 40′	.01	.01	.02	.03	.03	.04	.05	.05	.06	.06	.07	.08	.09	.09	.10	.10	.11	.12	.12	.13	.14	.14	.15	.16	.16	.17	.18	.18	.19	.20
41	.01	.01	.02	.03	.03	.04	.05	.05	.06	.06	.07	.08	.08	.09	.10	.10	.11	.12	.12	.13	.14	.14	.15	.16	.16	.17	.17	.18	.19	.19
42	.01	.01	.02	.03	.03	.04	.05	.05	.06	.06	.07	.08	.08	.09	.10	.10	.11	.12	.12	.13	.13	.14	.15	.15	.16	.17	.17	.18	.19	.19
43	.01	.01	.02	.03	.03	.04	.04	.05	.06	.06	.07	.08	.08	.09	.10	.10	.11	.11	.12	.13	.13	.14	.15	.15	.16	.16	.17	.18	.18	.19
44	.01	.01	.02	.03	.03	.04	.04	.05	.06	.06	.07	.08	.08	.09	.09	.10	.11	.11	.12	.13	.13	.14	.14	.15	.16	.16	.17	.17	.18	.19
1° 45′	.01	.01	.02	.03	.03	.04	.04	.05	.06	.06	.07	.07	.08	.09	.09	.10	.11	.11	.12	.12	.13	.14	.14	.15	.16	.16	.17	.17	.18	.19
46	.01	.01	.02	.03	.03	.04	.04	.05	.06	.06	.07	.07	.08	.09	.09	.10	.10	.11	.12	.12	.13	.14	.14	.15	.15	.16	.17	.17	.18	.18
47	.01	.01	.02	.02	.03	.04	.04	.05	.06	.06	.07	.07	.08	.09	.09	.10	.10	.11	.12	.12	.13	.13	.14	.15	.15	.16	.16	.17	.18	.18
48	.01	.01	.02	.02	.03	.04	.04	.05	.05	.06	.07	.07	.08	.08	.09	.10	.10	.11	.11	.12	.13	.13	.14	.14	.15	.16	.16	.17	.18	.18
49	.01	.01	.02	.02	.03	.04	.04	.05	.05	.06	.07	.07	.08	.08	.00	.10	.10	.11	.11	.12	.13	.13	.14	.14	.15	.16	.16	.17	.17	.18
1° 50′	.01	.01	.02	.02	.03	.04	.04	.05	.05	.06	.07	.07	.08	.08	.09	.10	.10	.11	.11	.12	.12	.13	.14	.14	.15	.15	.16	.16	.17	.18
51	.01	.01	.02	.02	.03	.04	.04	.05	.05	.06	.06	.07	.08	.08	.09	.09	.10	.11	.11	.12	.12	.13	.14	.14	.15	.15	.16	.16	.17	.18
52	.01	.01	.02	.02	.03	.04	.04	.05	.05	.06	.06	.07	.08	.08	.09	.09	.10	.11	.11	.12	.12	.13	.13	.14	.14	.15	.16	.16	.17	.17
53	.01	.01	.02	.02	.03	.04	.04	.05	.05	.06	.06	.07	.08	.08	.09	.09	.10	.11	.11	.12	.12	.13	.13	.14	.14	.15	.16	.16	.17	.17
54	.01	.01	.02	.02	.03	.03	.04	.05	.05	.06	.06	.07	.07	.08	.09	.09	.10	.10	.11	.11	.12	.13	.13	.14	.14	.15	.15	.16	.17	.17
1° 55′	.01	.01	.02	.02	.03	.03	.04	.05	.05	.06	.06	.07	.07	.08	.09	.09	.10	.10	.11	.11	.12	.13	.13	.14	.14	.15	.15	.16	.16	.17
56	.01	.01	.02	.02	.03	.03	.04	.05	.05	.06	.06	.07	.07	.08	.08	.09	.10	.10	.11	.11	.12	.12	.13	.14	.14	.15	.15	.16	.16	.17
57	.01	.01	.02	.02	.03	.03	.04	.04	.05	.06	.06	.07	.07	.08	.08	.09	.10	.10	.11	.11	.12	.12	.13	.13	.14	.15	.15	.16	.16	.17
58	.01	.01	.02	.02	.03	.03	.04	.04	.05	.06	.06	.07	.07	.08	.08	.09	.09	.10	.11	.11	.12	.12	.13	.13	.14	.14	.15	.15	.16	.16
59	.01	.01	.02	.02	.03	.03	.04	.04	.05	.06	.06	.07	.07	.08	.08	.09	.09	.10	.10	.11	.12	.12	.13	.13	.14	.14	.15	.15	.16	.16
2° 00′	.01	.01	.02	.02	.03	.03	.04	.04	.05	.05	.06	.07	.07	.08	.08	.09	.09	.10	.10	.11	.11	.12	.13	.13	.14	.14	.15	.15	.16	.16

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile*—Continued.

Angle of elevation.	Differences of elevation in feet.																													
° ′	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
1° 31′	.22	.23	.24	.24	.25	.26	.27	.27	.28	.29	.29	.30	.31	.32	.32	.33	.34	.34	.35	.36	.36	.37	.38	.39	.39	.40	.41	.42	.42	.43
32	.22	.23	.23	.24	.25	.26	.26	.27	.28	.28	.29	.30	.30	.31	.32	.33	.33	.34	.35	.35	.36	.37	.37	.38	.39	.40	.40	.41	.42	.42
33	.22	.22	.23	.24	.25	.25	.26	.27	.27	.28	.29	.29	.30	.31	.31	.32	.33	.34	.34	.35	.36	.36	.37	.38	.38	.39	.40	.41	.41	.42
34	.22	.22	.23	.24	.24	.25	.26	.26	.27	.28	.28	.29	.30	.30	.31	.32	.32	.33	.34	.35	.35	.36	.37	.37	.38	.39	.40	.40	.41	.41
1° 35′	.21	.22	.23	.23	.24	.25	.25	.26	.27	.27	.28	.29	.30	.30	.31	.32	.32	.33	.34	.34	.35	.36	.36	.37	.38	.38	.39	.40	.40	.41
36	.21	.22	.22	.23	.24	.24	.25	.26	.26	.27	.28	.28	.29	.30	.31	.31	.32	.32	.33	.34	.35	.35	.36	.37	.37	.38	.39	.39	.40	.41
37	.21	.22	.22	.23	.24	.24	.25	.26	.26	.27	.28	.28	.29	.30	.30	.31	.31	.32	.33	.34	.34	.35	.36	.36	.37	.38	.39	.39	.40	.40
38	.21	.21	.22	.23	.23	.24	.25	.25	.26	.27	.27	.28	.29	.29	.30	.30	.31	.32	.32	.33	.34	.35	.35	.36	.37	.37	.38	.38	.39	.40
39	.20	.21	.22	.22	.23	.24	.24	.25	.26	.26	.27	.28	.28	.29	.30	.30	.31	.32	.32	.33	.34	.34	.35	.36	.36	.37	.38	.38	.39	.39
1° 40′	.20	.21	.22	.22	.23	.23	.24	.25	.25	.26	.27	.27	.28	.29	.29	.30	.31	.31	.32	.33	.33	.34	.35	.35	.36	.36	.37	.38	.38	.39
41	.20	.21	.21	.22	.23	.23	.24	.25	.25	.26	.26	.27	.28	.28	.29	.30	.30	.31	.32	.32	.33	.34	.34	.35	.35	.36	.37	.37	.38	.39
42	.20	.20	.21	.22	.22	.23	.24	.24	.25	.26	.26	.27	.27	.28	.29	.29	.30	.31	.31	.32	.33	.33	.34	.34	.35	.36	.37	.37	.38	.38
43	.20	.20	.21	.22	.22	.23	.23	.24	.25	.25	.26	.27	.27	.28	.28	.29	.30	.30	.31	.32	.32	.33	.34	.34	.35	.35	.36	.37	.37	.38
44	.19	.20	.21	.21	.22	.23	.23	.24	.24	.25	.26	.26	.27	.27	.28	.29	.29	.30	.31	.31	.32	.33	.33	.34	.34	.35	.36	.36	.37	.38
1° 45′	.19	.20	.20	.21	.22	.22	.23	.24	.24	.25	.25	.26	.27	.27	.28	.28	.29	.30	.30	.31	.32	.32	.33	.34	.34	.35	.36	.36	.37	.37
46	.19	.20	.20	.21	.22	.22	.23	.23	.24	.25	.25	.26	.26	.27	.28	.28	.29	.30	.30	.31	.31	.32	.33	.33	.34	.34	.35	.36	.36	.37
47	.19	.20	.20	.21	.21	.22	.23	.23	.24	.21	.25	.26	.26	.27	.27	.28	.29	.29	.30	.30	.31	.32	.32	.33	.33	.34	.35	.35	.36	.37
48	.19	.19	.20	.21	.21	.22	.22	.23	.24	.24	.25	.25	.26	.27	.27	.28	.28	.29	.29	.30	.31	.31	.32	.33	.33	.34	.35	.35	.36	.36
49	.19	.19	.20	.20	.21	.22	.22	.23	.23	.24	.25	.25	.26	.26	.27	.27	.28	.29	.29	.30	.30	.31	.32	.32	.33	.33	.34	.35	.35	.36
1° 50′	.18	.19	.20	.20	.21	.21	.22	.33	.23	.24	.24	.25	.25	.26	.27	.27	.28	.28	.29	.30	.30	.31	.31	.32	.32	.33	.34	.34	.35	.36
51	.18	.19	.19	.20	.21	.21	.22	.22	.23	.23	.24	.25	.25	.26	.26	.27	.27	.28	.29	.29	.30	.31	.31	.32	.32	.33	.34	.34	.35	.35
52	.18	.19	.19	.20	.20	.21	.22	.22	.23	.23	.24	.24	.25	.26	.26	.27	.27	.28	.28	.29	.30	.30	.31	.31	.32	.32	.33	.34	.34	.35
53	.18	.19	.19	.20	.20	.21	.21	.22	.23	.23	.24	.24	.25	.25	.26	.26	.27	.28	.28	.29	.29	.30	.31	.31	.32	.32	.33	.33	.34	.35
54	.18	.18	.19	.19	.20	.21	.21	.22	.22	.23	.23	.24	.25	.25	.26	.26	.27	.27	.28	.29	.29	.30	.30	.31	.31	.32	.33	.33	.34	.34
1° 55′	.18	.18	.19	.19	.20	.20	.21	.22	.22	.23	.23	.24	.24	.25	.25	.26	.27	.27	.28	.28	.29	.30	.30	.31	.31	.32	.33	.33	.33	.34
56	.17	.18	.19	.19	.20	.20	.21	.21	.22	.22	.23	.24	.24	.25	.25	.26	.26	.27	.27	.28	.29	.29	.30	.30	.31	.31	.32	.32	.33	.34
57	.17	.18	.18	.19	.20	.20	.21	.21	.22	.22	.23	.23	.24	.24	.25	.26	.26	.27	.27	.28	.28	.29	.29	.30	.31	.31	.32	.32	.33	.33
58	.17	.18	.18	.19	.19	.20	.20	.21	.22	.22	.23	.23	.24	.24	.25	.25	.26	.26	.27	.28	.28	.29	.29	.30	.80	.31	.32	.32	.33	.33
59	.17	.18	.18	.19	.19	.20	.20	.21	.21	.22	.22	.23	.24	.24	.25	.25	.26	.26	.27	.27	.28	.28	.29	.30	.30	.31	.31	.32	.32	.33
2° 00′	.17	.17	.18	.18	.19	.20	.20	.21	.21	.22	.22	.23	.23	.24	.24	.25	.26	.26	.27	.27	.28	.28	.29	.29	.30	.30	.31	.31	.32	.33

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile*—Continued.

Angle of elevation.	Differences of elevation in feet.																													
° ′	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
1° 31′	.44	.44	.45	.46	.46	.47	.48	.49	.49	.50	.51	.51	.52	.53	.54	.54	.55	.56	.56	.57	.59	.59	.59	.60	.61	.62	.62	.63	.64	.64
32	.43	.44	.45	.45	.46	.47	.47	.48	.49	.49	.50	.51	.52	.52	.53	.54	.54	.55	.56	.57	.59	.58	.59	.59	.60	.61	.61	.62	.63	.64
33	.43	.43	.44	.45	.45	.46	.47	.48	.48	.49	.50	.50	.51	.52	.52	.53	.54	.55	.55	.56	.57	.57	.58	.59	.59	.60	.61	.62	.62	.63
34	.42	.43	.44	.44	.45	.46	.46	.47	.48	.48	.49	.50	.51	.51	.52	.53	.53	.54	.55	.55	.56	.57	.57	.58	.59	.60	.60	.61	.62	.62
1° 35′	.42	.42	.43	.44	.44	.45	.46	.47	.47	.48	.49	.49	.50	.51	.51	.52	.53	.53	.54	.55	.56	.56	.57	.58	.58	.59	.60	.60	.61	.62
36	.41	.42	.43	.43	.44	.45	.45	.46	.47	.47	.48	.49	.50	.50	.51	.52	.52	.53	.54	.54	.55	.56	.56	.57	.58	.58	.59	.60	.60	.61
37	.41	.42	.42	.43	.44	.44	.45	.46	.46	.47	.48	.48	.49	.50	.50	.51	.52	.52	.53	.54	.54	.55	.56	.56	.57	.58	.58	.59	.60	.60
38	.41	.41	.42	.43	.43	.44	.45	.45	.46	.47	.47	.48	.49	.49	.50	.51	.51	.52	.53	.53	.54	.54	.55	.56	.56	.57	.58	.58	.59	.60
39	.40	.41	.41	.42	.43	.43	.44	.45	.45	.46	.47	.47	.48	.49	.49	.50	.51	.51	.52	.53	.53	.54	.54	.55	.56	.57	.57	.58	.59	.59
1° 40′	.40	.40	.41	.42	.42	.43	.44	.44	.45	.46	.46	.47	.48	.48	.49	.50	.50	.51	.51	.52	.53	.53	.54	.55	.55	.56	.57	.57	.58	.59
41	.39	.40	.41	.41	.42	.43	.43	.44	.44	.45	.46	.46	.47	.48	.48	.49	.50	.50	.51	.52	.52	.53	.54	.54	.55	.55	.56	.57	.57	.58
42	.39	.40	.40	.41	.41	.42	.43	.43	.44	.45	.45	.46	.47	.47	.48	.49	.49	.50	.50	.51	.52	.52	.53	.54	.54	.55	.56	.56	.57	.57
43	.39	.39	.40	.40	.41	.42	.42	.43	.44	.44	.45	.46	.46	.47	.47	.49	.49	.49	.50	.51	.51	.52	.53	.53	.54	.54	.55	.56	.56	.57
44	.38	.39	.39	.40	.41	.41	.42	.43	.43	.44	.44	.45	.46	.46	.47	.48	.48	.49	.49	.50	.51	.51	.52	.53	.53	.54	.54	.55	.56	.56
1° 45′	.38	.38	.39	.40	.40	.41	.42	.42	.43	.43	.44	.45	.45	.46	.46	.48	.48	.48	.49	.50	.50	.51	.51	.52	.53	.53	.54	.55	.55	.56
46	.37	.38	.39	.39	.40	.41	.41	.42	.42	.43	.44	.44	.45	.45	.46	.48	.47	.48	.49	.49	.50	.50	.51	.52	.52	.53	.53	.54	.55	.55
47	.37	.38	.38	.39	.39	.40	.41	.41	.42	.43	.43	.44	.44	.45	.46	.47	.47	.47	.48	.49	.49	.50	.50	.51	.52	.52	.53	.54	.54	.55
48	37	.37	.38	.39	.39	.40	.40	.41	.42	.42	.43	.43	.44	.45	.45	.47	.46	.47	.48	.48	.49	.49	.50	.51	.51	.52	.52	.53	.54	.54
49	.36	.37	.38	.38	.39	.39	.49	.41	.41	.42	.42	.43	.44	.44	.45	.46	.46	.47	.47	.48	.48	.49	.50	.50	.51	.51	.52	.53	.53	.54
1° 50′	.36	.37	.37	.38	.38	.39	.40	.40	.41	.41	.42	.43	.43	.44	.44	.46	.45	.46	.47	.47	.48	.49	.49	.50	.50	.51	.51	.52	.53	.53
51	.36	.36	.37	.38	.38	.39	.39	.40	.40	.41	.42	.42	.43	.43	.44	.45	.45	.46	.46	.47	.48	.48	.49	.49	.50	.50	.51	.52	.52	.53
52	.35	.36	.37	.37	.37	.38	.39	.40	.40	.41	.41	.42	.42	.43	.44	.45	.45	.45	.46	.47	.47	.48	.48	.49	.49	.50	.51	.51	.52	.52
53	.35	.36	.36	.37	.37	.38	.39	.39	.40	.40	.41	.41	.42	.43	.43	.44	.44	.45	.45	.46	.47	.47	.48	.48	.49	.50	.50	.51	.51	.52
54	.35	.35	.36	.37	.37	.38	.38	.39	.39	.40	.41	.41	.42	.42	.43	.44	.44	.45	.45	.46	.46	.47	.47	.48	.49	.49	.50	.50	.51	.51
1° 55′	.34	.35	.36	.36	.37	.37	.38	.39	.39	.40	.40	.41	.41	.42	.43	.44	.44	.44	.45	.45	.46	.46	.47	.48	.48	.49	.49	.50	.50	.51
56	.34	.35	.35	.36	.36	.37	.38	.38	.39	.39	.40	.40	.41	.42	.42	.43	.43	.44	.44	.45	.45	.46	.47	.47	.48	.48	.49	.49	.50	.51
57	.34	.35	.35	.36	.36	.37	.37	.38	.38	.39	.40	.40	.41	.41	.42	.43	.43	.43	.44	.44	.45	.46	.46	.47	.47	.48	.48	.49	.50	.50
58	.34	.34	.35	.35	.36	.36	.37	.38	.38	.39	.39	.40	.40	.41	.41	.43	.42	.43	.44	.44	.45	.45	.46	.46	.47	.47	.48	.49	.49	.50
59	.33	.34	.34	.35	.35	.36	.37	.37	.38	.38	.39	.39	.40	.40	.41	.42	.42	.43	.43	.44	.44	.45	.45	.46	.46	.47	.48	.48	.49	.49
2° 00′	.33	.34	.34	.35	.35	.36	.36	.37	.37	.38	.39	.39	.40	.40	.41	.42	.42	.42	.43	.43	.44	.44	.45	.46	.46	.47	.47	.48	.48	.49

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile*—Continued.

Angle of elevation.	Differences of elevation in feet.																													
° ′	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
1° 31′	.65	.66	.67	.67	.68	.69	.69	.70	.71	.72	.72	.73	.74	.74	.75	.76	.77	.77	.78	.79	.79	.80	.81	.82	.82	.83	.84	.84	.85	.86
32	.64	.65	.66	.67	.67	.68	.69	.69	.70	.71	.71	.72	.73	.74	.74	.75	.76	.76	.77	.78	.78	.79	.80	.81	.81	.82	.83	.83	.84	.85
33	.64	.64	.65	.66	.66	.67	.68	.68	.69	.70	.71	.71	.72	.73	.73	.74	.76	.76	.76	.77	.78	.78	.79	.80	.80	.81	.82	.83	.83	.85
34	.63	.64	.64	.65	.66	.66	.67	.68	.68	.69	.70	.71	.71	.72	.73	.73	.74	.75	.75	.76	.77	.78	.78	.79	.80	.80	.81	.82	.82	.84
1° 35′	.62	.63	.64	.64	.65	.66	.66	.67	.68	.69	.69	.70	.71	.71	.72	.73	.73	.74	.75	.75	.76	.77	.77	.78	.79	.80	.80	.81	.82	.83
36	.62	.62	.63	.64	.64	.65	.66	.67	.67	.68	.68	.69	.70	.71	.71	.72	.73	.73	.74	.75	.75	.76	.77	.77	.78	.79	.79	.80	.81	.82
37	.61	.62	.62	.63	.64	.64	.65	.66	.66	.67	.68	.68	.69	.70	.71	.71	.72	.73	.73	.74	.75	.75	.76	.77	.77	.78	.79	.79	.80	.81
38	60	.61	.62	.62	.63	.64	.64	.65	.66	.66	.67	.68	.68	.69	.70	.70	.71	.72	.72	.73	.74	.74	.75	.76	.76	.77	.78	.78	.79	.80
39	.60	.60	.61	.62	.62	.63	.64	.64	.65	.66	.66	.67	.68	.68	.69	.70	.70	.71	.72	.72	.73	.74	.74	.75	.76	.76	.77	.78	.78	.80
1° 40′	.59	.60	.61	.61	.62	.62	.63	.64	.64	.65	.66	.66	.67	.68	.68	.69	.70	.70	.71	.72	.72	.73	.73	.74	.75	.75	.76	.77	.77	.79
41	.59	.59	.60	.61	.61	.62	.63	.63	.64	.64	65	.66	.66	.67	.68	.68	.69	.70	.70	.71	.71	.72	.73	.73	.74	.75	.75	.76	.77	.78
42	.58	.59	.59	.60	.61	.61	.62	.63	.63	.64	.64	.65	.66	.66	.67	.68	.68	.69	.70	.70	.71	.72	.72	.73	.73	.74	.75	.75	.76	.77
43	.58	.58	.59	.59	.60	.61	.61	.62	.63	.63	.64	.65	.65	.66	.66	.67	.68	.68	.69	.70	.70	.71	.71	.72	.73	.73	.74	.75	.75	.77
44	.57	.58	.58	.59	.60	.60	.61	.61	.62	.63	.63	.64	.64	.65	.66	.66	.67	.68	.68	.69	.69	.70	.71	.71	.72	.73	.73	.74	.74	.75
1° 45′	.56	.57	.58	.58	.59	.59	.60	.61	.61	.62	.63	.63	.64	.64	.65	.66	.66	.67	.68	.68	.69	.69	.70	.71	.71	.72	.72	.73	.74	.75
46	.56	.57	.57	.58	.58	.59	.60	.60	.61	.62	.62	.63	.63	.64	.65	.65	.66	.66	.67	.68	.68	.69	.70	.70	.71	.71	.72	.73	.73	.74
47	.55	.56	.57	.57	.58	.58	.59	.60	.60	.61	.61	.62	.63	.63	.64	.64	.65	.66	.66	.67	.68	.68	.69	.69	.70	.71	.71	.72	.72	.74
48	.55	.55	.56	.57	.57	.58	.58	.59	.60	.60	.61	.61	.62	.63	.63	.64	.64	.65	.66	.66	.67	.67	.68	.69	.69	.70	.70	.71	.72	.73
49	.54	.55	.56	.56	.57	.57	.58	.59	.59	.60	.60	.61	.62	.62	.63	.63	.64	.65	.65	.66	.66	.67	.68	.68	.68	.69	.70	.70	.71	.72
1° 50′	.54	.54	.55	.56	.56	.57	.57	.58	.59	.59	.60	.60	.61	.62	.62	.63	.63	.64	.64	.65	.66	.66	.67	.67	.68	.69	.69	.70	.70	.72
51	.53	.54	.55	.55	.56	.56	.57	.57	.58	.59	.59	.60	.60	.61	.62	.62	.63	.63	.64	.65	.65	.66	.66	.67	.67	.68	.69	.69	.70	.71
52	.53	.53	.54	.55	.55	.56	.56	.57	.58	.58	.59	.59	.60	.60	.61	.62	.62	.63	.63	.64	.65	.65	.66	.66	.67	.67	.68	.69	.69	.70
53	.52	.53	.54	.54	.55	.55	.56	.56	.57	.58	.58	.59	.59	.60	.60	.61	.62	.62	.63	.63	.64	.64	.65	.66	.66	.67	.67	.68	.68	.70
54	.52	.52	.53	.54	.54	.54	.55	.56	.56	.57	.58	.58	.59	.59	.60	.60	.61	.62	.62	.63	.63	.64	.64	.65	.66	.66	.67	.67	.68	.69
1° 55′	.52	.52	.53	.53	.54	.54	.55	.55	.56	.57	.57	.58	.58	.59	.59	.60	.61	.61	.62	.62	.63	.63	.64	.65	.65	.66	.66	.67	.67	.69
56	.51	.52	.52	.53	.53	.54	.54	.55	.55	.56	.57	.57	.58	.58	.59	.59	.60	.61	.61	.62	.62	.63	.63	.64	.65	.65	.66	.66	.67	.68
57	.51	.51	.52	.52	.53	.53	.54	.54	.55	.56	.56	.57	.57	.58	.58	.59	.60	.60	.61	.61	.62	.62	.63	.63	.64	.65	.65	.66	.66	.67
58	.50	.51	.51	.52	.52	.53	.53	.54	.54	.55	.56	.56	.57	.57	.58	.58	.59	.60	.60	.61	.61	.62	.62	.63	.63	.64	.65	.65	.66	.67
59	.50	.50	.51	.51	.52	.52	.53	.53	.54	.55	.55	.56	.56	.57	.57	.58	.58	.59	.60	.60	.61	.61	.62	.62	.63	.63	.64	.64	.65	.66
2° 00′	.49	.50	.50	.51	.51	.52	.53	.53	.54	.54	.55	.55	.56	.56	.57	.57	.58	.59	.59	.60	.60	.61	.61	.62	.62	.63	.63	.64	.65	.66

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile*—Continued.

Angle of elevation.	Differences of elevation in feet.																													
° ′	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
1° 31′	.87	.87	.88	.89	.89	.90	.91	.92	.93	.93	.94	.94	.95	.96	.97	.97	.98	.99	.99	1.0	......	......	......	......	......	......	......	......	......	......
32	.86	.86	.87	.88	.88	.89	.90	.91	.91	.92	.93	.93	.94	.95	.96	.96	.97	.98	.98	.99	1.0	......	......	......	......	......	......	......	......	......
33	.85	.85	.86	.87	.87	.88	.89	.90	.90	.91	.92	.92	.93	.94	.95	.95	.96	.97	.97	.98	.99	.99	1.0	......	......	......	......	......	......	......
34	.84	.84	.85	.86	.87	.87	.88	.89	.89	.90	.91	.91	.92	.93	.94	.94	.95	.96	.96	.97	.98	.98	.99	1.0	......	......	......	......	......	......
1° 35′	.83	.84	.84	.85	.86	.86	.87	.88	.88	.89	.90	.90	.91	.92	.93	.93	.94	.95	.95	.96	.97	.97	.98	.99	.99	1.0	......	......	......	......
36	.82	.83	.83	.84	.85	.85	.86	.87	.88	.88	.89	.90	.90	.91	.92	.92	.93	.94	.94	.95	.96	.96	.97	.98	.98	.99	1.0	......	......	......
37	.81	.82	.83	.83	.84	.85	.85	.86	.87	.87	.88	.89	.89	.90	.91	.91	.92	.93	.93	.94	.95	.95	.96	.97	.97	.98	.99	.99	1.0	......
38	.80	.81	.82	.82	.83	.84	.84	.85	.86	.86	.87	.88	.88	.89	.90	.90	.91	.92	.92	.93	.94	.94	.95	.96	.96	.97	.98	.98	.99	1.0
39	.80	.80	.81	.81	.82	.83	.83	.84	.85	.85	.86	.87	.87	.88	.89	.89	.90	.91	.91	.92	.93	.93	.94	.95	.95	.96	.97	.97	.98	.99
1° 40′	.79	.79	.80	.81	.81	.82	.83	.83	.84	.85	.85	.86	.87	.87	.88	.88	.89	.90	.90	.91	.92	.92	.93	.94	.94	.95	.96	.96	.97	.98
41	.78	.79	.79	.80	.81	.81	.82	.82	.83	.84	.84	.85	.86	.86	.87	.88	.88	.89	.90	.90	.91	.91	.92	.93	.93	.94	.95	.95	.96	.97
42	.77	.78	.79	.79	.80	.80	.81	.82	.82	.83	.84	.84	.85	.86	.86	.87	.87	.88	.89	.89	.90	.91	.91	.92	.93	.93	.94	.94	.95	.96
43	.77	.77	.78	.78	.79	.80	.80	.81	.82	.82	.83	.83	.84	.85	.85	.86	.87	.87	.88	.89	.89	.90	.90	.91	.92	.92	.93	.94	.94	.95
44	.76	.76	.77	.78	.78	.79	.80	.80	.81	.81	.82	.83	.83	.84	.84	.85	.86	.86	.87	.88	.88	.89	.89	.90	.91	.91	.92	.93	.93	.94
1° 45′	.75	.76	.76	.77	.77	.78	.79	.79	.80	.81	.81	.82	.82	.83	.84	.84	.85	.85	.86	.87	.87	.88	.89	.89	.90	.90	.91	.92	.92	.93
46	.74	.75	.76	.76	.77	.78	.78	.79	.79	.80	.81	.81	.82	.82	.83	.84	.84	.85	.86	.86	.87	.87	.88	.89	.89	.90	.90	.91	.92	.92
47	.74	.74	.75	.75	.76	.77	.77	.78	.78	.79	.80	.80	.81	.82	.82	.83	.83	.84	.85	.85	.86	.86	.87	.88	.88	.89	.89	.90	.91	.91
48	.73	.73	.74	.75	.75	.76	.77	.77	.78	.78	.79	.80	.80	.81	.81	.82	.83	.83	.84	.84	.85	.86	.86	.87	.87	.88	.89	.89	.90	.90
49	.72	.73	.73	.74	.75	.75	.76	.76	.77	.78	.78	.79	.79	.80	.81	.81	.82	.82	.83	.84	.84	.85	.85	.86	.87	.87	.88	.88	.89	.90
1° 50′	.72	.72	.73	.73	.74	.75	.75	.76	.76	.77	.77	.78	.79	.79	.80	.80	.81	.82	.82	.83	.83	.84	.85	.85	.86	.86	.87	.88	.88	.89
51	.71	.72	.72	.73	.73	.74	.74	.75	.76	.76	.77	.77	.78	.79	.79	.80	.80	.81	.82	.82	.83	.83	.84	.84	.85	.86	.86	.87	.87	.88
52	.70	.71	.72	.72	.73	.73	.74	.74	.75	.76	.76	.77	.77	.78	.78	.79	.80	.80	.81	.81	.82	.83	.83	.84	.84	.85	.85	.86	.87	.87
53	.70	.70	.71	.71	.72	.73	.73	.74	.74	.75	.75	.76	.77	.77	.78	.78	.79	.79	.80	.81	.81	.82	.82	.83	.83	.84	.85	.85	.86	.86
54	.69	.70	.70	.71	.71	.72	.72	.73	.74	.74	.75	.75	.76	.76	.77	.78	.78	.79	.79	.80	.80	.81	.82	.82	.83	.83	.84	.84	.85	.86
1° 55′	.69	.69	.70	.70	.71	.71	.72	.72	.73	.74	.74	.75	.75	.76	.76	.77	.78	.78	.79	.79	.80	.80	.81	.82	.82	.83	.83	.84	.84	.85
56	.68	.68	.69	.70	.70	.71	.71	.72	.72	.73	.74	.74	.74	.75	.76	.76	.77	.77	.78	.79	.79	.80	.80	.81	.81	.82	.83	.83	.84	.84
57	.67	.68	.68	.69	.70	.70	.71	.71	.72	.72	.73	.73	.74	.74	.75	.76	.76	.77	.77	.78	.78	.79	.80	.80	.81	.81	.82	.82	.83	.83
58	.67	.67	.68	.68	.69	.69	.70	.70	.71	.72	.72	.73	.73	.74	.74	.75	.76	.76	.77	.77	.78	.78	.79	.79	.80	.80	.81	.82	.82	.83
59	.66	.67	.67	.68	.68	.69	.69	.70	.70	.71	.72	.72	.73	.73	.74	.74	.75	.75	.76	.76	.77	.78	.78	.79	.79	.80	.80	.81	.81	.82
2° 00′	.66	.67	.67	.67	.68	.68	.69	.69	.70	.71	.71	.72	.72	.73	.73	.74	.74	.75	.75	.76	.77	.77	.78	.78	.79	.79	.80	.80	.81	.81

TABLE VI.—*Differences of altitude to the nearest foot for angles from 1 minute to 2 degrees and for distances under 1 mile*—Continued.

Angle of elevation.	Differences of elevation in feet.																		
° ′	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169
1° 31′	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
32	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
33	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
34	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1° 35	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
36	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
37	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
38	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
39	.99	1. 0	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
1° 40′	.98	.99	.99	1. 0	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
41	.97	.98	.98	.99	1. 0	......	......	......	......	......	......	......	......	......	......	......	......	......	......
42	.96	.97	.98	.98	.99	1. 0	......	......	......	......	......	......	......	......	......	......	......	......	......
43	.95	.96	.97	.97	.98	.99	.99	1. 0	......	......	......	......	......	......	......	......	......	......	......
44	.94	.95	.96	.96	.97	.98	.98	.99	.99	1. 0	......	......	......	......	......	......	......	......	......
1° 45′	.94	.94	.95	.95	.96	.97	.97	.98	.98	.99	1. 0	......	......	......	......	......	......	......	......
46	.93	.93	.94	.95	.95	.96	.97	.97	.98	.98	.99	1. 0	......	......	......	......	......	......	......
47	.92	.92	.93	.94	.94	.95	.96	.96	.97	.97	.98	.99	.99	1. 0	......	......	......	......	......
48	.91	.92	.92	.93	.93	.94	.95	.95	.96	.96	.97	.98	.98	.99	.99	1. 0	......	......	......
49	.90	.91	.91	.92	.93	.93	.94	.94	.95	.96	.96	.97	.97	.98	.99	.99	1. 0	......	......
1° 50′	.89	.90	.90	.91	.92	.92	.93	.93	.94	.95	.95	.96	.96	.97	.98	.98	.99	.99	1. 0
51	.89	.89	.90	.90	.91	.91	.92	.93	.93	.94	.94	.95	.96	.96	.97	.97	.98	.98	.99
52	.88	.88	.89	.90	.90	.90	.91	.92	.92	.93	.94	.94	.95	.95	.96	.96	.97	.98	.98
53	.87	.87	.88	.89	.89	.90	.90	.91	.91	.92	.93	.93	.94	.94	.95	.96	.96	.97	.97
54	.86	.87	.87	.88	.88	.89	.90	.90	.91	.91	.92	.92	.93	.94	.94	.95	.95	.96	.96
1° 55′	.86	.86	.87	.87	.88	.88	.89	.89	.90	.91	.91	.92	.92	.93	.93	.94	.95	.95	.96
56	.85	.85	.86	.86	.87	.88	.88	.89	.89	.90	.90	.91	.91	.92	.93	.93	.94	.94	.95
57	.84	.85	.85	.86	.86	.87	.87	.88	.88	.89	.90	.90	.91	.91	.92	.92	.93	.93	.94
58	.83	.84	.84	.85	.85	.86	.87	.87	.88	.88	.89	.89	.90	.90	.91	.92	.92	.93	.93
59	.82	.83	.84	.84	.85	.85	.86	.86	.87	.87	.88	.89	.89	.90	.90	.91	.91	.92	.92
2° 00′	.82	.82	.83	.84	.84	.85	.85	.86	.86	.87	.87	.88	.88	.89	.89	.90	.91	.91	.91

Angle of elevation.	170	171	172	178	174	175	176	177	178	179	180
51	1. 0	......	......	......	......	......	......	......	......	......	......
52	.99	.99	1. 0	......	......	......	......	......	......	......	......
53	.98	.98	.99	1. 0	......	......	......	......	......	......	......
54	.97	.98	.98	.99	.99	1. 0	......	......	......	......	......
1° 55′	.96	.97	.97	.98	.99	.99	1. 0	......	......	......	......
56	.95	.96	.97	.97	.98	.98	.99	.99	1. 0	......	......
57	.95	.95	.96	.96	.97	.97	.98	.98	.99	1. 0	......
58	.94	.94	.95	.95	.96	.96	.97	.98	.98	.99	.99
59	.93	.93	.94	.95	.95	.96	.96	.97	.97	.98	.98
2° 00′	.92	.93	.93	.94	.94	.95	.95	.96	.97	.97	.98

Angle of elevation.	Differences of elevation in feet.			
° ′	181	182	183	184
1° 58′	1. 0	......	......	......
59	.99	.99	1. 0	......
2° 00′	.98	.99	.99	1. 0

TABLE VII.—*Differences of altitude from angles of elevation or depression.*

Difference of altitude = $\begin{cases} +Dh_1 + h_2 \text{ for angles of elevation.} \\ -Dh_1 + h_2 \text{ for angles of depression.} \end{cases}$

D = distance in miles, α = angle of elevation or depression; h_1 = 5280 ft. × tan α; h_2 = correction for curvature and refraction. Argument for h_1 is α; argument for h_2 is D.

	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°
	h_1	h_1	h_1	h_1	h_1	h_1	h_1	h_1	h_1	h_1	h_1	h_1	h_1	h_1	h_1	h_1
′	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
0	0.0	92.2	184.4	276.7	369.2	461.9	555.0	648.3	742.0	836.3	931.0	1026.3	1122.3	1219.0	1316.5	1414.8
1	1.5	93.7	185.9	278.2	370.7	463.5	556.5	649.9	743.6	837.8	932.6	1027.9	1123.9	1220.6	1318.1	1416.4
2	3.1	95.2	187.4	279.8	372.3	465.0	558.0	651.4	745.2	839.4	934.2	1029.5	1125.5	1222.2	1319.7	1418.0
3	4.6	96.8	189.0	281.3	373.8	466.6	559.6	653.0	746.7	841.0	935.8	1031.1	1127.1	1223.8	1321.3	1419.7
4	6.1	98.3	190.5	282.9	375.4	468.1	561.2	654.5	748.3	842.6	937.3	1032.7	1128.7	1225.5	1323.0	1421.3
5	7.7	99.8	192.1	284.4	376.9	469.7	562.7	656.1	749.9	844.1	938.9	1034.3	1130.3	1227.1	1324.6	1423.0
6	9.2	101.4	193.6	286.0	378.5	471.2	564.3	657.7	751.4	845.7	940.5	1035.9	1131.9	1228.7	1326.2	1424.6
7	10.7	102.9	195.1	287.5	380.0	472.8	565.8	659.2	753.0	847.3	942.1	1037.5	1133.5	1230.3	1327.9	1423.9
8	12.3	104.4	196.7	289.0	381.6	474.3	567.4	660.8	754.6	848.9	943.7	1039.1	1135.2	1231.9	1329.5	1427.9
9	13.8	106.0	198.2	290.6	383.1	475.9	568.9	662.3	756.1	850.4	945.3	1040.7	1136.8	1233.6	1331.1	1429.6
10	15.4	107.5	199.8	292.1	384.6	477.4	570.5	663.9	757.7	852.0	946.8	1042.3	1138.4	1235.2	1332.8	1431.2
11	16.9	109.1	201.3	293.7	386.2	479.0	572.0	665.5	759.3	853.6	948.4	1043.8	1140.0	1236.8	1334.4	1432.9
12	18.4	110.6	202.8	295.2	387.7	480.5	573.6	667.0	760.9	855.2	950.0	1045.4	1141.6	1238.4	1335.0	1434.5
13	20.0	112.1	204.4	296.7	389.3	482.1	575.1	668.6	762.4	856.8	951.6	1047.0	1143.2	1240.0	1337.7	1436.2
14	21.5	113.7	205.9	298.3	390.8	483.6	576.7	670.1	765.0	858.3	953.2	1048.6	1144.8	1241.7	1339.3	1437.8
15	23.0	115.2	207.5	299.8	392.4	485.2	578.2	671.7	765.6	859.9	954.7	1050.2	1146.4	1243.3	1340.9	1439.5
16	24.6	116.7	209.0	301.3	393.9	486.7	579.8	673.3	767.1	861.5	956.3	1051.8	1148.0	1244.9	1342.6	1441.1
17	26.1	118.3	210.5	302.9	395.5	488.3	581.3	674.8	768.7	863.0	957.9	1053.4	1149.6	1246.5	1344.2	1442.8
18	27.6	119.8	212.1	304.4	397.0	489.8	582.9	676.4	770.3	864.6	959.5	1055.0	1151.2	1248.1	1345.8	1444.4
19	29.2	121.4	213.6	306.0	398.6	491.3	584.4	677.9	771.8	866.2	961.1	1056.6	1152.8	1249.8	1347.5	1446.1
20	30.7	122.9	215.1	307.5	400.1	492.9	586.0	679.5	773.4	867.8	962.7	1058.2	1154.4	1251.4	1349.1	1447.7
21	32.3	124.4	216.7	309.1	401.6	494.5	587.6	681.1	775.0	869.4	964.3	1059.8	1156.1	1253.0	1350.8	1449.4
22	33.8	126.0	218.2	310.6	403.2	496.0	589.1	682.6	776.5	870.9	965.9	1061.4	1157.7	1254.6	1352.4	1451.0
23	35.3	127.5	219.8	312.1	404.7	497.6	590.7	684.2	778.1	872.5	967.5	1063.0	1159.3	1256.2	1354.0	1452.7
24	36.9	129.0	221.3	313.7	406.3	499.1	592.2	685.7	779.7	874.1	969.0	1064.6	1160.9	1257.9	1355.7	1454.4
25	38.4	130.6	222.8	315.2	407.8	500.7	593.8	687.3	781.3	875.7	970.6	1066.2	1162.5	1259.5	1357.3	1456.0
26	39.9	132.1	224.4	316.8	409.4	502.2	595.4	688.9	782.8	877.3	972.2	1067.8	1164.1	1261.1	1358.9	1457.7
27	41.5	133.6	225.9	318.3	410.9	503.8	596.9	690.4	784.4	878.8	973.8	1069.4	1165.7	1162.7	1360.6	1459.3
28	43.0	135.2	227.4	319.9	412.5	505.3	598.5	692.0	786.0	880.4	975.4	1071.0	1167.3	1264.4	1362.2	1461.0
29	44.5	136.7	229.0	321.4	414.0	506.9	600.0	693.6	787.5	882.0	977.0	1072.6	1168.9	1266.0	1363.9	1462.6
30	46.1	138.3	230.5	322.9	415.5	508.4	601.6	695.1	789.1	883.6	978.6	1074.2	1170.6	1267.6	1365.5	1464.3
31	47.6	139.8	232.1	324.5	417.1	510.0	603.1	696.7	790.7	885.1	980.1	1075.8	1172.2	1269.3	1367.1	1465.9
32	49.2	141.3	233.6	326.0	418.6	511.5	604.7	698.2	792.2	886.7	981.7	1077.4	1173.8	1270.9	1368.8	1467.6
33	50.7	142.9	235.1	327.6	420.2	513.0	606.2	699.8	793.8	888.3	983.3	1079.0	1175.4	1272.5	1370.4	1469.2
34	52.2	144.4	236.7	329.1	421.7	514.6	607.8	701.4	795.4	889.9	984.9	1080.6	1177.0	1274.1	1372.1	1470.9
35	53.8	146.0	238.2	330.6	423.3	516.2	609.3	702.9	797.0	891.5	986.5	1082.2	1178.6	1275.7	1373.7	1472.5
36	55.3	147.5	239.8	332.2	424.8	517.7	610.9	704.5	798.5	893.0	988.1	1083.8	1180.2	1277.4	1375.3	1474.2
37	56.8	149.0	241.3	333.7	426.4	519.3	612.5	706.1	800.1	894.6	989.7	1085.4	1181.8	1279.0	1377.0	1475.9
38	58.4	150.6	242.8	335.3	427.9	520.8	614.0	707.6	801.7	896.2	991.3	1087.0	1183.4	1280.6	1378.6	1477.5
39	59.9	152.1	244.4	336.8	429.5	522.4	615.6	709.2	803.2	897.8	992.9	1088.6	1185.0	1282.2	1380.3	1479.2
40	61.4	153.6	245.9	338.4	431.0	523.9	617.1	710.7	804.8	899.4	994.5	1090.2	1186.7	1283.9	1381.9	1480.8
41	63.0	155.2	247.5	339.9	432.6	525.5	618.7	712.3	806.4	900.9	996.0	1091.8	1188.3	1285.5	1383.5	1482.5
42	64.5	156.7	249.0	341.4	434.1	527.0	620.2	713.9	807.9	902.5	997.6	1093.4	1189.9	1287.1	1385.2	1484.1
43	66.0	158.2	250.5	343.0	435.6	528.6	621.8	715.4	809.5	904.1	999.2	1095.0	1191.5	1288.8	1386.8	1485.8
44	67.6	159.8	252.1	344.5	437.2	530.1	623.3	717.0	811.1	905.7	1000.8	1096.6	1193.1	1290.4	1388.5	1487.5
45	69.1	161.3	253.6	346.1	438.7	531.7	624.9	718.6	812.7	907.3	1002.4	1098.2	1194.7	1292.0	1390.1	1489.1
46	70.6	162.9	255.1	347.6	440.3	533.2	626.4	720.1	814.2	908.8	1004.0	1099.8	1196.3	1293.7	1391.8	1490.8
47	72.2	164.4	256.7	349.1	441.8	534.8	628.0	721.7	815.8	910.4	1005.6	1101.5	1197.9	1295.3	1393.4	1492.4
48	73.7	165.9	258.2	350.7	443.4	536.3	629.6	723.3	817.4	912.0	1007.2	1103.1	1199.6	1296.9	1395.0	1494.1
49	75.3	167.5	259.8	352.2	444.9	537.9	631.1	724.8	819.0	913.6	1008.8	1104.7	1201.2	1298.5	1396.7	1495.8
50	76.8	169.0	261.3	353.8	446.5	539.4	632.7	726.4	820.5	915.2	1010.4	1106.3	1202.8	1300.2	1398.3	1497.4
51	78.3	170.6	262.8	355.3	448.0	541.0	634.2	728.0	822.1	916.7	1012.0	1107.9	1204.4	1301.8	1400.0	1499.1
52	79.9	172.1	264.4	356.9	449.6	542.5	635.8	729.5	823.7	918.3	1013.6	1109.5	1206.0	1303.4	1401.6	1500.7
53	81.4	173.6	265.9	358.4	451.1	544.1	637.3	731.1	825.2	919.9	1015.2	1111.1	1207.7	1305.0	1403.3	1502.4
54	82.9	175.2	267.5	360.0	452.7	545.1	638.9	732.7	826.8	921.5	1016.8	1112.7	1209.3	1306.7	1404.9	1504.1
55	84.5	176.7	269.0	361.5	454.2	547.2	640.4	734.2	828.4	923.1	1018.4	1114.3	1210.9	1308.3	1406.5	1505.7
56	86.0	178.2	270.5	363.0	455.8	548.7	642.0	735.8	830.0	924.7	1020.0	1115.9	1212.5	1309.9	1408.2	1507.4
57	87.5	179.8	272.1	364.6	457.3	550.3	643.6	737.4	831.5	926.2	1021.5	1117.5	1214.1	1311.6	1409.8	1509.0
58	89.1	181.3	273.6	366.1	458.9	551.8	645.1	738.9	833.1	927.8	1023.1	1119.1	1215.8	1313.2	1410.5	1510.7
59	90.6	182.9	275.2	367.7	460.4	553.4	646.7	740.5	834.7	929.4	1024.7	1120.7	1217.4	1314.8	1413.1	1512.4
60	92.2	184.4	276.7	369.2	461.9	555.0	648.3	742.0	836.3	931.0	1026.3	1122.3	1219.0	1316.5	1414.8	1514.0

TABLE VIII.—*Corrections for curvature and refraction.*

D	h_2	D	h_2	D	h_2	D	h_2
Miles.	*Feet.*	*Miles.*	*Feet.*	*Miles.*	*Feet.*	*Miles.*	*Feet.*
1.0	0.6	5.5	17.3				
1.1	0.7	5.6	18.0	3.6	7.4	8.1	37.6
1.2	0.8	5.7	18.6	3.7	7.8	8.2	38.6
1.3	1.0	5.8	19.3	3.8	8.3	8.3	39.5
1.4	1.1	5.9	20.0	3.9	8.7	8.4	40.5
1.5	1.3	6.0	20.6	4.0	9.2	8.5	41.4
1.6	1.5	6.1	21.3	4.1	9.6	8.6	42.4
1.7	1.7	6.2	22.0	4.2	10.1	8.7	43.4
1.8	1.9	6.3	22.8	4.3	10.6	8.8	44.4
1.9	2.1	6.4	23.5	4.4	11.1	8.9	45.4
2.0	2.3	6.5	24.2	4.5	11.6	9.0	46.4
2.1	2.5	6.6	25.0	4.6	12.1	9.1	47.5
2.2	2.8	6.7	25.7	4.7	12.7	9.2	48.5
2.3	3.0	6.8	26.5	4.8	13.2	9.3	49.6
2.4	3.3	6.9	27.3	4.9	13.8	9.4	50.7
2.5	3.6	7.0	28.1	5.0	14.3	9.5	51.7
2.6	3.9	7.1	28.9	5.1	14.9	9.6	52.8
2.7	4.2	7.2	29.7	5.2	15.5	9.7	53.9
2.8	4.5	7.3	30.5	5.3	16.1	9.8	55.1
2.9	4.8	7.4	31.4	5.4	16.7	9.9	56.2
3.0	5.2	7.5	32.2	5.5	17.3	10.0	57.3
3.1	5.5	7.6	33.1				
3.2	5.9	7.7	34.0				
3.3	6.2	7.8	34.9				
3.4	6.6	7.9	35.8				
3.5	7.0	8.0	36.7				

TABLE IX.—*For computing differences of altitude from angles of elevation or depression (applicable to scale 1:45000).*

[Prepared by R. S. Woodward.]

Difference of altitude $= \begin{cases} + Dh_1 + h_2 \text{ for angles of elevation.} \\ - Dh_1 + h_2 \text{ for angles of depression.} \end{cases}$

D = distance in scale divisions $\frac{1}{50}$ inch each; a = angle of elevation or depression; $h_1 = 75$ feet × tan a; h_2 = correction for curvature and refraction.

Argument for h_1 is a; argument for h_2 is D.

	h_1 in feet.								D	h_2	D	h_2
'	0°	1°	2°	3°	4°	5°	6°	7°	Scale divisions.	Feet.	Scale divisions.	Feet.
0	.000	1.309	2.619	3.931	5.245	6.562	7.882	9.208	00	0	720	60
1	.022	1.331	2.641	3.952	5.266	6.583	7.905	9.231	93	1	726	61
2	.043	1.353	2.662	3.974	5.288	6.605	7.927	9.253	131	2	732	62
3	.065	1.375	2.684	3.996	5.310	6.628	7.949	9.275	161	3	738	63
4	.087	1.396	2.707	4.018	5.332	6.649	7.971	9.298	186	4	744	64
5	.109	1.418	2.728	4.040	5.354	6.671	7.993	9.319	208	5	750	65
6	.131	1.440	2.750	4.062	5.376	6.694	8.015	9.342	228	6	755	66
7	.153	1.462	2.772	4.084	5.398	6.715	8.037	9.364	246	7	761	67
8	.175	1.483	2.794	4.105	5.420	6.737	8.059	9.386	263	8	767	68
9	.196	1.505	2.815	4.127	5.442	6.760	8.081	9.408	279	9	772	69
10	.218	1.527	2.837	4.150	5.464	6.781	8.104	9.430	294	10	778	70
11	.240	1.549	2.859	4.171	5.485	6.803	8.125	9.452	308	11	783	71
12	.262	1.571	2.881	4.193	5.508	6.826	8.147	9.475	322	12	789	72
13	.283	1.593	2.903	4.215	5.530	6.847	8.170	9.496	335	13	794	73
14	.305	1.615	2.925	4.237	5.551	6.869	8.191	9.519	348	14	800	74
15	.327	1.636	2.947	4.258	5.573	6.892	8.214	9.541	360	15	805	75
16	.349	1.658	2.968	4.281	5.596	6.913	8.236	9.563	372	16	811	76
17	.371	1.680	2.990	4.303	5.617	6.935	8.258	9.586	383	17	816	77
18	.393	1.702	3.012	4.324	5.639	6.958	8.280	9.607	394	18	821	78
19	.415	1.723	3.034	4.346	5.661	6.979	8.302	9.630	405	19	826	79
20	.436	1.746	3.056	4.368	5.683	7.001	8.324	9.652	416	20	832	80
21	.458	1.768	3.078	4.390	5.705	7.024	8.346	9.674	426	21	837	81
22	.480	1.789	3.100	4.412	5.727	7.045	8.368	9.697	436	22	842	82
23	.502	1.811	3.121	4.434	5.749	7.067	8.390	9.718	446	23	847	83
24	.523	1.833	3.143	4.456	5.771	7.090	8.413	9.741	455	24	852	84
25	.545	1.855	3.165	4.477	5.793	7.111	8.434	9.763	465	25	857	85
26	.567	1.875	3.187	4.499	5.815	7.133	8.457	9.785	474	26	862	86
27	.589	1.898	3.209	4.522	5.836	7.156	8.479	9.807	483	27	867	87
28	.610	1.920	3.231	4.543	5.859	7.177	8.501	9.829	492	28	872	88
29	.633	1.942	3.253	4.565	5.881	7.200	8.523	9.852	501	29	877	89
30	.655	1.964	3.274	4.587	5.902	7.222	8.545	9.874	509	30	882	90
31	.676	1.986	3.296	4.609	5.924	7.243	8.567	9.896	518	31	887	91
32	.698	2.008	3.318	4.631	5.947	7.266	8.589	9.918	526	32	892	92
33	.720	2.029	3.340	4.653	5.968	7.288	8.611	9.940	534	33	897	93
34	.742	2.051	3.362	4.675	5.990	7.309	8.633	9.963	542	34	901	94
35	.763	2.073	3.384	4.696	6.013	7.332	8.656	9.985	550	35	906	95
36	.785	2.095	3.406	4.718	6.034	7.354	8.677	10.007	558	36	911	96
37	.807	2.116	3.427	4.741	6.056	7.375	8.700	10.029	566	37	916	97
38	.829	2.138	3.449	4.762	6.078	7.398	8.722	10.051	573	38	920	98
39	.851	2.161	3.471	4.784	6.100	7.420	8.744	10.074	581	39	925	99
40	.873	2.182	3.493	4.806	6.122	7.442	8.766	10.096	588	40	930	100
41	.895	2.204	3.515	4.828	6.144	7.464	8.788	10.118	595	41	934	101
42	.916	2.226	3.537	4.850	6.166	7.486	8.810	10.141	603	42	939	102
43	.938	2.248	3.559	4.872	6.188	7.508	8.833	10.162	610	43	943	103
44	.960	2.269	3.580	4.894	6.210	7.530	8.854	10.185	617	44	948	104
45	.982	2.291	3.602	4.915	6.232	7.552	8.877	10.207	624	45	953	105
46	1.003	2.313	3.624	4.938	6.254	7.574	8.899	10.229	631	46	957	106
47	1.025	2.335	3.646	4.960	6.276	7.596	8.921	10.252	637	47	962	107
48	1.047	2.357	3.668	4.981	6.298	7.618	8.943	10.273	644	48	966	108
49	1.069	2.379	3.690	5.003	6.320	7.640	8.965	10.296	651	49	971	109
50	1.091	2.401	3.712	5.025	6.342	7.662	8.987	10.318	657	50	975	110
51	1.113	2.422	3.733	5.047	6.364	7.684	9.010	10.340	664	51	980	111
52	1.135	2.444	3.755	5.069	6.385	7.706	9.031	10.363	670	52	984	112
53	1.156	2.466	3.776	5.091	6.408	7.729	9.054	10.384	677	53	988	113
54	1.178	2.488	3.799	5.113	6.430	7.750	9.076	10.407	683	54	993	114
55	1.200	2.509	3.821	5.135	6.451	7.772	9.098	10.429	690	55	997	115
56	1.222	2.532	3.843	5.157	6.474	7.795	9.120	10.451	696	56	1001	116
57	1.243	2.554	3.865	5.179	6.496	7.816	9.142	10.474	702	57	1005	117
58	1.265	2.575	3.886	5.200	6.517	7.839	9.164	10.496	708	58	1010	118
59	1.287	2.597	3.909	5.222	6.540	7.861	9.187	10.518	714	59	1014	119
60	1.309	2.619	3.931	5.245	6.562	7.882	9.208	10.540	720	60	1018	120

TABLE IX.—*For computing differences of altitude from angles of elevation or depression (applicable to scale 1:45000)*—Continued.

h_1 in feet.									D	h_2	D	h_2
′	8°	9°	10°	11°	12°	13°	14°	15°	Scale divisions.	Feet.	Scale divisions.	Feet.
0	10.540	11.878	13.225	14.578	15.942	17.315	18.700	20.096	00	0	720	60
1	10.563	11.901	13.247	14.601	15.964	17.338	18.723	20.119	93	1	726	61
2	10.585	11.923	13.270	14.623	15.987	17.361	18.746	20.143	131	2	732	62
3	10.607	11.946	13.292	14.647	16.010	17.384	18.769	20.166	161	3	738	63
4	10.630	11.968	13.315	14.669	16.033	17.407	18.792	20.190	186	4	744	64
5	10.651	11.991	13.337	14.692	16.056	17.430	18.815	20.213	208	5	750	65
6	10.674	12.013	13.360	14,714	16.078	17.453	18.838	20.236	228	6	755	66
7	10.696	12.035	13.382	14.737	16.102	17.476	18.862	20.260	246	7	761	67
8	10.718	12.059	13.405	14.760	16.124	17.499	18.885	20.283	263	8	767	68
9	10.741	12.080	13.427	14.782	16.147	17.522	18.908	20.307	279	9	772	69
10	10.763	12.103	13.450	14.805	16.170	17.545	18.931	20.330	294	10	778	70
11	10.786	12.125	13.472	14.828	16.192	17.568	18.955	20.353	308	11	783	71
12	10.807	12.147	13.495	14.851	16.216	17.591	18.978	20.377	322	12	789	72
13	10.830	12.169	13.517	14.873	16.238	17.614	19.001	20.401	335	13	794	73
14	10.852	12.192	13.540	14.896	16.261	17.637	19.024	20.424	348	14	800	74
15	10.874	12.214	13.562	14.918	16.284	17.660	19.048	20.447	360	15	805	75
16	10.897	12.237	13.585	14.941	16.307	17.683	19.071	20.470	372	16	811	76
17	10.919	12.259	13.607	14.964	16.330	17.706	19.094	20.494	383	17	816	77
18	10.941	12.282	13.630	14.986	16.353	17.729	19.117	20.518	394	18	821	78
19	10.963	12.304	13.652	15.009	16.375	17.752	19.142	20.541	405	19	826	79
20	10.986	12.326	13.675	15.031	16.398	17.775	19.164	20.564	416	20	832	80
21	11.008	12.349	13.697	15.055	16.421	17.798	19.187	20.588	426	21	837	81
22	11.030	12.371	13.720	15.077	16.444	17.821	19.210	20.611	436	22	842	82
23	11.053	12.394	13.742	15.100	16.467	17.845	19.234	20.635	446	23	847	83
24	11.075	12.416	13.765	15.123	16.489	17.867	19.257	20.659	455	24	852	84
25	11.097	12.439	13.787	15.145	16.513	17.890	19.280	20.682	465	25	857	85
26	11.119	12.461	13.810	15.168	16.535	17.914	19.303	20.705	474	26	862	86
27	11.142	12.484	13.833	15.190	16.558	17.937	19.327	20.728	483	27	867	87
28	11.164	12.505	13.855	15.214	16.581	17.959	19.350	20.752	492	28	872	88
29	11.186	12.528	13.878	15.236	16.604	17.983	19.373	20.776	501	29	877	89
30	11.209	12.550	13.909	15.259	16.627	18.006	19.396	20.799	509	30	882	90
31	11.231	12.573	13.923	15.282	16.650	18.029	19.420	20.823	518	31	887	91
32	11.254	12.595	13.945	15.304	16.673	18.052	19.443	20.846	526	32	892	92
33	11.275	12.618	13.968	15.327	16.696	18.075	19.466	20.869	534	32	897	93
34	11.298	12.640	13.990	15.349	16.719	18.097	19.489	20.893	542	34	901	94
35	11.320	12.663	14.013	15.373	16.741	18.121	19.513	20.917	550	35	906	95
36	11.343	12.685	14.035	15.395	16.765	18.145	19.536	20.940	558	36	911	96
37	11.365	12.708	14.059	15.418	16.787	18.167	19.559	20.964	566	37	916	97
38	11.387	12.730	14.081	15.441	16.810	18.190	19.582	20.987	573	38	920	98
39	11.410	12.753	14.104	15.463	16.833	18.214	19.606	21.011	581	39	925	99
40	11.432	12.775	14.126	15.486	16.856	18.237	19.629	21.034	588	40	930	100
41	11.454	12.797	14.149	15.509	16.879	18.260	19.652	21.058	595	41	934	101
42	11.476	12.820	14.171	15.532	16.902	18.283	19.676	21.082	603	42	939	102
43	11.499	12.842	14.194	15.554	16.925	18.306	19.699	21.105	610	43	943	103
44	11.521	12.865	14.216	15.577	16.948	18.329	19.723	21.129	617	44	948	104
45	11.543	12.887	14.239	15.600	16.971	18.352	19.746	21.152	624	45	953	105
46	11.566	12.910	14.262	15.622	16.993	18.376	19.769	21.175	631	46	957	106
47	11.588	12.932	14.284	15.646	17.017	18.399	19.792	21.199	637	47	962	107
48	11.611	12.955	14.307	15.668	17.039	18.421	19.816	21.223	644	48	966	108
49	11.633	12.977	14.329	15.691	17.062	18.445	19.839	21.247	651	49	971	109
50	11.655	13.000	14.352	15.714	17.086	18.468	19.862	21.270	657	50	975	110
51	11.677	13.022	14.374	15.736	17.108	18.491	19.886	21.293	664	51	980	111
52	11.700	13.045	14.398	15.760	17.131	18.514	19.909	21.317	670	52	984	112
53	11.722	13.067	14.420	15.782	17.154	18.538	19.933	21.340	677	53	988	113
54	11.745	13.090	14.443	15.805	17.177	18.560	19.956	21.364	683	54	993	114
55	11.767	13.112	14.465	15.828	17.200	18.583	19.979	21.388	690	55	997	115
56	11.789	13.135	14.488	15.850	17.223	18.607	20.002	21.412	696	56	1001	116
57	11.812	13.157	14.510	15.873	17.246	18.630	20.026	21.435	702	57	1005	117
58	11.834	13.180	14.533	15.896	17.269	18.653	20.050	21.459	708	59	1010	118
59	11.857	13.202	14.556	15.919	17.292	18.676	20.073	21.482	714	58	1014	119
60	11.878	13.225	14.578	15.942	17.315	18.700	20.096	21.506	720	60	1018	120

TABLE X.—*For computing differences of altitude from angles of elevation or depression (applicable to scale of 1:30000).*

[Prepared by R. S. Woodward.]

Difference of altitude $=\begin{cases}+Dh_1+h_2 \text{ for angles of elevation.}\\ -Dh_1+h_2 \text{ for angles of depression.}\end{cases}$

D = distance in scale divisions $\frac{1}{50}$ inch each; α = angle of elevation or depression; h_1 = 50 feet × tan α; h_2 = correction for curvature and refraction.

Argument for h_1 is α; argument for h_2 is D.

h_1 in feet.									D	h_2	D	h_2
′	0°	1°	2°	3°	4°	5°	6°	7°	Scale divisions.	Feet.	Scale divisions.	Feet.
0	.000	.873	1.746	2.620	3.496	4.374	5.255	6.139	000	0	1080	60
1	.014	.887	1.760	2.635	3.511	4.389	5.270	6.154	139	1	1089	61
2	.029	.902	1.775	2.649	3.525	4.403	5.284	6.169	197	2	1098	62
3	.043	.916	1.789	2.664	3.540	4.418	5.299	6.183	242	3	1107	63
4	.058	.931	1.804	2.678	3.555	4.433	5.314	6.198	279	4	1116	64
5	.072	.945	1.819	2.693	3.569	4.447	5.328	6.213	312	5	1124	65
6	.087	.960	1.833	2.708	3.584	4.462	5.543	6.228	342	6	1133	66
7	.102	.974	1.848	2.722	3.598	4.477	5.358	6.242	369	7	1141	67
8	.116	.989	1.862	2.737	3.613	4.491	5.373	6.257	394	8	1150	68
9	.131	1.003	1.877	2.751	3.628	4.506	5.387	6.272	418	9	1158	69
10	.145	1.018	1.891	2.766	3.642	4.521	5.402	6.287	441	10	1167	70
11	.160	1.033	1.906	2.781	3.657	4.535	5.417	6.301	462	11	1175	71
12	.174	1.047	1.921	2.795	3.672	4.550	5.431	6.316	483	12	1183	72
13	.189	1.062	1.935	2.810	3.686	4.565	5.446	6.331	503	13	1191	73
14	.203	1.076	1.950	2.824	3.701	4.579	5.461	6.346	522	14	1199	74
15	.218	1.091	1.964	2.839	3.715	4.594	5.476	6.361	540	15	1208	75
16	.232	1.105	1.979	2.854	3.730	4.609	5.490	6.375	558	16	1216	76
17	.247	1.120	1.993	2.868	3.745	4.623	5 505	6.390	575	17	1224	77
18	.262	1.134	2.008	2.883	3.759	4.638	5.520	6.405	592	18	1231	78
19	.276	1.149	2.023	2.897	3.774	4.653	5.535	6.420	608	19	1239	79
20	.291	1.164	2.037	2.912	3.789	4.667	5.549	6.434	624	20	1247	80
21	.305	1.178	2.052	2.927	3.803	4.682	5.564	6.449	639	21	1255	81
22	.320	1.193	2.066	2.941	3.818	4.697	5.579	6.464	654	22	1263	82
23	.334	1.207	2.081	2.956	3.832	1.711	5.593	6.479	669	23	1270	83
24	.349	1.222	2.095	2.970	3.847	4.726	5.608	6.494	683	24	1278	84
25	.363	1.236	2.110	2.985	3.862	4.741	5.623	6.508	697	25	1286	85
26	.378	1.250	2.125	2.999	3.876	4.755	5.638	6.523	711	26	1293	86
27	.392	1.265	2.139	3.014	3.891	4.770	5.652	6.538	725	27	1301	87
28	.407	1.280	2.154	3.029	3.906	4.785	5.667	6.553	738	28	1308	88
29	.422	1.294	2.168	3.043	3.920	4.800	5.682	6.568	751	29	1315	89
30	.436	1.309	2.183	3.058	3.935	4.814	5.697	6.582	764	30	1323	90
31	.451	1.324	2.197	3.072	3.949	4.829	5.711	6.597	776	31	1330	91
32	.465	1.338	2.212	3.087	3.964	4.844	5.726	6.612	789	32	1337	92
33	.480	1.353	2.227	3.102	3.979	4.858	5.741	6.627	801	33	1345	93
34	.494	1.367	2.241	3.116	3.993	4.873	5.755	6.642	813	34	1352	94
35	.509	1.382	2.256	3.131	4.008	4.888	5.770	6.656	825	35	1359	95
36	.523	1.396	2.270	3.145	4.023	4.902	5.785	6.671	837	36	1366	96
37	.538	1.411	2.285	3.160	4.037	4.917	5.800	6.686	848	37	1373	97
38	.552	1.425	2.289	3.175	4.052	4.932	5.814	6.701	860	38	1380	98
39	.567	1.440	2.314	3.189	4.067	4.946	5.829	6.716	871	39	1387	99
40	.582	1.455	2.329	3.204	4.081	4.961	5.844	6.730	882	40	1394	100
41	.596	1.469	2.343	3.218	4.096	4.976	5.859	6.745	893	41	1401	101
42	.611	1.484	2.358	3.233	4.110	4.990	5.873	6.760	904	42	1408	102
43	.625	1.498	2.372	3.248	4.125	5.005	5.888	6.775	914	43	1415	103
44	.640	1.513	2.387	3.262	4.140	5.020	5.903	6.790	925	44	1422	104
45	.654	1.527	2.401	3.277	4.154	5.034	5.918	6.804	935	45	1429	105
46	.669	1.542	2.416	3.292	4.169	5.049	5.932	6.819	946	46	1436	106
47	.683	1.557	2.431	3.306	4.184	5.064	5.947	6.834	956	47	1442	107
48	.698	1.571	2.445	3.321	4.198	5.079	5.962	6.849	966	48	1449	108
49	.712	1.586	2.460	3.335	4.213	5.093	5.977	6.864	976	49	1456	109
50	.727	1.600	2.474	3.350	4.228	5.108	5.991	6.879	986	50	1462	110
51	.742	1.615	2.489	3.365	4.242	5.123	6.006	6.893	996	51	1469	111
52	.756	1.629	2.503	3.379	4.257	5.137	6.021	6.908	1006	52	1476	112
53	.771	1.644	2.517	3.394	4.272	5.152	6.036	6.923	1015	53	1482	113
54	.785	1.658	2.533	3.408	4.286	5.167	6.050	6.938	1025	54	1489	114
55	.800	1.673	2.547	3.423	4.301	5.181	6.065	6.953	1034	55	1495	115
56	.814	1.688	2.562	3.438	4.316	5.196	6.080	6.967	1043	56	1502	116
57	.829	1.702	2.576	3.452	4.330	5.211	6.095	6.982	1053	57	1508	117
58	.843	1.717	2.591	3.467	4.345	5.226	6.109	6.997	1062	58	1515	118
59	.858	1.731	2.606	3.481	4.360	5.240	6.124	7.012	1071	59	1521	119
60	.873	1.746	2.620	3.496	4.374	5.255	6.139	7.027	1080	60	1527	120

TABLE X.—*For computing differences of altitude from angles of elevation or depression (applicable to scale of 1: 30000*—Continued.

h_1 in feet.									D	h_2	D	h_2
′	8°	9°	10°	11°	12°	13°	14°	15°	Scale divisions.	Feet.	Scale divisions.	Feet.
0	7.027	7.919	8.816	9.719	10.628	11.543	12.466	13.397	**000**	0	**1080**	60
1	7.042	7.934	8.831	9.734	10.643	11.558	12.482	13.413	**139**	1	**1089**	61
2	7.056	7.949	8.846	9.749	10.658	11.574	12.497	13.428	**197**	2	**1098**	62
3	7.071	7.964	8.861	9.764	10.673	11.589	12.513	13.444	**242**	3	**1107**	63
4	7.086	7.979	8.876	9.779	10.688	11.604	12.528	13.460	**279**	4	**1116**	64
5	7.101	7.994	8.891	9.794	10.704	11.620	12.543	13.475	**312**	5	**1124**	65
6	7.116	8.008	8.906	9.809	10.719	11.635	12.559	13.491	**342**	6	**1133**	66
7	7.131	8.023	8.921	9.824	10.734	11.650	12.574	13.506	**369**	7	**1141**	67
8	7.145	8.038	8.936	9.840	10.749	11.666	12.590	13.522	**394**	8	**1150**	68
9	7.160	8.053	8.951	9.855	10.764	11.681	12.605	13.538	**418**	9	**1158**	69
10	7.175	8.068	8.966	9.870	10.780	11.696	12.621	13.553	**441**	10	**1167**	70
11	7.190	8.083	8.981	9.885	10.795	11.712	12.636	13.569	**462**	11	**1175**	71
12	7.205	8.098	8.996	9.900	10.810	11.727	12.652	13.584	**483**	12	**1183**	72
13	7.220	8.113	9.011	9.915	10.825	11.742	12.667	13.600	**503**	13	**1191**	73
14	7.235	8.128	9.026	9.930	10.841	11.758	12.683	13.616	**522**	14	**1199**	74
15	7.249	8.143	9.041	9.945	10.856	11.773	12.698	13.631	**540**	15	**1208**	75
16	7.264	8.158	9.056	9.960	10.871	11.789	12.714	13.647	**558**	16	**1216**	76
17	7.279	8.173	9.071	9.976	10.886	11.804	12.729	13.663	**575**	17	**1224**	77
18	7.294	8.188	9.086	9.991	10.902	11.819	12.745	13.678	**592**	18	**1231**	78
19	7.309	8.202	9.101	10.006	10.917	11.835	12.761	13.694	**608**	19	**1239**	79
20	7.324	8.217	9.116	10.021	10.932	11.850	12.776	13.709	**624**	20	**1247**	80
21	7.339	8.232	9.131	10.036	10.947	11.865	12.791	13.725	**639**	21	**1255**	81
22	7.353	8.247	9.146	10.051	10.962	11.881	12.807	13.741	**654**	22	**1263**	82
23	7.368	8.262	9.161	10.066	10.978	11.896	12.822	13.756	**669**	23	**1270**	83
24	7.383	8.277	9.176	10.082	10.993	11.911	12.838	13.772	**683**	24	**1278**	84
25	7.398	8.292	9.191	10.097	11.008	11.927	12.853	13.788	**697**	25	**1286**	85
26	7.413	8.307	9.207	10.112	11.023	11.942	12.869	13.803	**711**	26	**1293**	86
27	7.428	8.322	9.222	10.127	11.039	11.958	12.884	13.819	**725**	27	**1301**	87
28	7.443	8.337	9.237	10.142	11.054	11.973	12.900	13.835	**738**	28	**1308**	88
29	7.457	8.352	9.252	10.157	11.069	11.988	12.915	13.850	**751**	29	**1315**	89
30	7.472	8.367	9.267	10.172	11.084	12.004	12.931	13.866	**764**	30	**1323**	90
31	7.487	8.382	9.282	10.188	11.100	12.019	12.946	13.882	**776**	31	**1330**	91
32	7.502	8.397	9.297	10.203	11.115	12.034	12.962	13.897	**789**	32	**1337**	92
33	7.517	8.412	9.312	10.218	11.130	12.050	12.977	13.913	**801**	33	**1345**	93
34	7.532	8.427	9.327	10.233	11.146	12.065	12.993	13.929	**813**	34	**1352**	94
35	7.547	8.442	9.342	10.248	11.161	12.081	13.008	13.944	**825**	35	**1359**	95
36	7.562	8.457	9.357	10.263	11.176	12.096	13.024	13.960	**837**	36	**1366**	96
37	7.576	8.472	9.372	10.278	11.191	12.111	13.039	13.976	**848**	37	**1373**	97
38	7.591	8.487	9.387	10.294	11.207	12.127	13.055	13.991	**860**	38	**1380**	98
39	7.606	8.502	9.402	10.309	11.222	12.142	13.070	14.007	**871**	39	**1387**	99
40	7.621	8.516	9.417	10.324	11.237	12.158	13.086	14.023	**882**	40	**1394**	100
41	7.636	8.531	9.432	10.339	11.252	12.173	13.101	14.038	**893**	41	**1401**	101
42	7.651	8.546	9.447	10.354	11.268	12.188	13.117	14.054	**904**	42	**1408**	102
43	7.666	8.561	9.462	10.369	11.283	12.204	13.133	14.070	**914**	43	**1415**	103
44	7.681	8.576	9.477	10.385	11.298	12.219	13.148	14.086	**925**	44	**1422**	104
45	7.695	8.591	9.493	10.400	11.314	12.235	13.164	14.101	**935**	45	**1429**	105
46	7.710	8.606	9.508	10.415	11.329	12.250	13.179	14.117	**946**	46	**1436**	106
47	7.725	8.621	9.523	10.431	11.344	12.266	13.195	14.133	**956**	47	**1442**	107
48	7.740	8.636	9.538	10.445	11.359	12.281	13.210	14.148	**966**	48	**1449**	108
49	7.755	8.651	9.553	10.460	11.375	12.296	13.226	14.164	**976**	49	**1456**	109
50	7.770	8.666	9.568	10.476	11.390	12.312	13.241	14.180	**986**	50	**1462**	110
51	7.785	8.681	9.583	10.491	11.405	12.327	13.257	14.195	**996**	51	**1469**	111
52	7.800	8.696	9.598	10.506	11.421	12.343	13.273	14.211	**1006**	52	**1476**	112
53	7.815	8.711	9.613	10.521	11.436	12.358	13.288	14.227	**1015**	53	**1482**	113
54	7.830	8.726	9.628	10.536	11.451	12.373	13.304	14.243	**1025**	54	**1489**	114
55	7.844	8.741	9.643	10.552	11.467	12.389	13.319	14.258	**1034**	55	**1495**	115
56	7.859	8.756	9.658	10.567	11.482	12.404	13.335	14.274	**1043**	56	**1502**	116
57	7.874	8.771	9.673	10.582	11.497	12.420	13.350	14.290	**1053**	57	**1508**	117
58	7.889	8.786	9.689	10.597	11.513	12.435	13.366	14.306	**1062**	58	**1515**	118
59	7.904	8.801	9.704	10.612	11.528	12.451	13.382	14.321	**1071**	59	**1521**	119
60	7.919	8.816	9.719	10.628	11.543	12.466	13.397	14.337	1080	60	1527	120

TABLE XI.—*Differences of altitude*

[Prepared by

Computed from the formula $h = D \sin a \cos a$, in which D is the observed distance of the

a	D 560	D 580	D 600	D 620	D 640	D 660	D 680	D 700	D 720	D 740	D 760	D 780	D 800	D 820
° ′														
0 01	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
0 02	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5
0 03	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7
0 04	0.6	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	1.0
0 05	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.2	1.2
0 06	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4
0 07	1.1	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.5	1.5	1.6	1.6	1.6	1.7
0 08	1.3	1.4	1.4	1.4	1.5	1.5	1.6	1.6	1.7	1.7	1.8	1.8	1.9	1.9
0 09	1.5	1.5	1.6	1.6	1.7	1.7	1.8	1.8	1.9	1.9	2.0	2.0	2.1	2.1
0 10	1.6	1.7	1.7	1.8	1.9	1.9	2.0	2.0	2.1	2.2	2.2	2.3	2.3	2.4
0 11	1.8	1.9	1.9	2.0	2.0	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.6	2.6
0 12	2.0	2.0	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.6	2.7	2.7	2.8	2.9
0 13	2.1	2.2	2.3	2.3	2.4	2.5	2.6	2.6	2.7	2.8	2.9	2.9	3.0	3.1
0 14	2.3	2.4	2.4	2.5	2.6	2.7	2.8	2.8	2.9	3.0	3.1	3.2	3.3	3.3
0 15	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.1	3.2	3.3	3.4	3.5	3.6
0 16	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.3	3.4	3.5	3.6	3.7	3.8
0 17	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1
0 18	2.9	3.0	3.1	3.2	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3
0 19	3.1	3.2	3.3	3.4	3.5	3.6	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5
0 20	3.3	3.4	3.5	3.6	3.7	3.8	4.0	4.1	4.2	4.3	4.4	4.5	4.7	4.8
0 21	3.4	3.5	3.7	3.8	3.9	4.0	4.2	4.3	4.4	4.5	4.6	4.8	4.9	5.0
0 22	3.6	3.7	3.8	4.0	4.1	4.2	4.4	4.5	4.6	4.7	4.9	5.0	5.1	5.2
0 23	3.7	3.9	4.0	4.1	4.3	4.4	4.5	4.7	4.8	5.0	5.1	5.2	5.4	5.5
0 24	3.9	4.0	4.2	4.3	4.5	4.6	4.7	4.9	5.0	5.2	5.3	5.4	5.6	5.7
0 25	4.1	4.2	4.4	4.5	4.7	4.8	4.9	5.1	5.2	5.4	5.5	5.7	5.8	6.0
0 26	4.2	4.4	4.5	4.7	4.8	5.0	5.1	5.3	5.4	5.6	5.7	5.9	6.0	6.2
0 27	4.4	4.6	4.7	4.9	5.0	5.2	5.3	5.5	5.7	5.8	6.0	6.1	6.3	6.4
0 28	4.6	4.7	4.9	5.0	5.2	5.4	5.5	5.7	5.9	6.0	6.2	6.3	6.5	6.7
0 29	4.7	4.9	5.1	5.2	5.4	5.6	5.7	5.9	6.1	6.2	6.4	6.6	6.8	6.9
0 30	4.9	5.1	5.2	5.4	5.6	5.8	5.9	6.1	6.3	6.5	6.6	6.8	7.0	7.2
0 35	5.7	5.9	6.1	6.3	6.5	6.7	6.9	7.1	7.3	7.5	7.7	7.9	8.1	8.4
0 40	6.5	6.7	7.0	7.2	7.4	7.7	7.9	8.1	8.4	8.6	8.8	9.1	9.3	9.5
0 45	7.3	7.6	7.9	8.1	8.4	8.6	8.9	9.2	9.4	9.7	9.9	10.2	10.5	10.7
0 50	8.1	8.4	8.7	9.0	9.3	9.6	9.9	10.2	10.5	10.8	11.1	11.3	11.6	11.9
0 55	9.0	9.3	9.6	9.9	10.2	10.6	10.9	11.2	11.5	11.8	12.2	12.5	12.8	13.1
1 00	9.8	10.1	10.5	10.8	11.2	11.5	11.9	12.2	12.6	12.9	13.3	13.6	14.0	14.3
1 10	11.4	11.8	12.2	12.6	13.0	13.4	13.8	14.3	14.7	15.1	15.5	15.9	16.3	16.7
1 20	13.0	13.5	14.0	14.4	14.9	15.4	15.8	16.3	16.7	17.2	17.7	18.1	18.6	19.1
1 30	14.7	15.2	15.7	16.2	16.7	17.3	17.8	18.3	18.8	19.4	19.9	20.4	20.9	21.5
1 40	16.3	16.9	17.4	18.0	18.6	19.2	19.8	20.3	20.9	21.5	22.1	22.7	23.3	23.8
1 50	17.9	18.5	19.2	19.8	20.5	21.1	21.7	22.4	23.0	23.7	24.3	24.9	25.6	26.2
2 00	19.5	20.2	20.9	21.6	22.3	23.0	23.7	24.4	25.1	25.8	26.5	27.2	27.9	28.6
2 10	21.2	21.9	22.7	23.4	24.2	24.9	25.7	26.4	27.2	28.0	28.7	29.5	30.2	31.0
2 20	22.8	23.6	24.4	25.2	26.0	26.8	27.7	28.5	29.3	30.1	30.9	31.7	32.5	33.4
2 30	24.4	25.3	26.1	27.0	27.9	28.8	29.6	30.5	31.4	32.2	33.1	34.0	34.9	35.7
2 40	26.0	27.0	27.9	28.8	29.7	30.7	31.6	32.5	33.5	34.4	35.3	36.3	37.2	38.1
2 50	27.6	28.6	29.6	30.6	31.6	32.6	33.6	34.6	35.5	36.5	37.5	38.5	39.5	40.5
3 00	29.3	30.3	31.4	32.4	33.4	34.5	35.5	36.6	37.6	38.7	39.7	40.8	41.8	42.9
4 00	39.0	40.4	41.8	43.1	44.5	45.9	47.3	48.7	50.1	51.5	52.9	54.3	55.7	57.1
5 00	48.6	50.4	52.1	53.8	55.6	57.3	59.0	60.8	62.5	64.2	66.0	67.7	69.5	71.2
a	D 560	D 580	D 600	D 620	D 640	D 660	D 680	D 700	D 720	D 740	D 760	D 780	D 800	D 820

from telemeter measures.

R. S. Woodward.]

telemeter staff, a is the angle of elevation or depression, and h is the difference in height.

D 840	D 860	D 880	D 900	D 920	D 940	D 960	D 980	D 1,000	D 1,100	D 1,200	D 1,300	D 1,400	D 1,500	D 2,000
0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.6
0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.8	0.8	0.9	1.2
0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.2	1.3	1.7
1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.3
1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.6	1.7	1.9	2.0	2.2	2.9
1.5	1.5	1.5	1.6	1.6	1.6	1.7	1.7	1.7	1.9	2.1	2.3	2.4	2.6	3.5
1.7	1.8	1.8	1.8	1.9	1.9	2.0	2.0	2.0	2.2	2.4	2.7	2.9	3.1	4.1
2.0	2.0	2.1	2.1	2.1	2.2	2.2	2.3	2.3	2.6	2.8	3.0	3.3	3.5	4.7
2.2	2.3	2.3	2.4	2.4	2.5	2.5	2.6	2.6	2.9	3.1	3.4	3.7	3.9	5.2
2.4	2.5	2.6	2.6	2.7	2.7	2.8	2.9	2.9	3.2	3.5	3.8	4.1	4.4	5.8
2.7	2.8	2.8	2.9	2.9	3.0	3.1	3.1	3.2	3.5	3.8	4.2	4.5	4.8	6.4
2.9	3.0	3.1	3.1	3.2	3.3	3.4	3.4	3.5	3.8	4.2	4.5	4.9	5.2	7.0
3.2	3.3	3.3	3.4	3.5	3.6	3.6	3.7	3.8	4.2	4.5	4.9	5.3	5.7	7.6
3.4	3.5	3.6	3.7	3.7	3.8	3.9	4.0	4.1	4.5	4.9	5.3	5.7	6.1	8.1
3.7	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.8	5.2	5.7	6.1	6.5	8.7
3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	5.1	5.6	6.0	6.5	7.0	9.3
4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.4	5.9	6.4	6.9	7.4	9.9
4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.8	6.3	6.8	7.3	7.9	10.5
4.6	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	6.1	6.6	7.2	7.7	8.3	11.1
4.9	5.0	5.1	5.2	5.4	5.5	5.6	5.7	5.8	6.4	7.0	7.5	8.1	8.7	11.6
5.1	5.3	5.4	5.5	5.6	5.7	5.9	6.0	6.1	6.7	7.3	7.9	8.6	9.2	12.2
5.4	5.5	5.6	5.8	5.9	6.0	6.1	6.3	6.4	7.0	7.7	8.3	9.0	9.6	12.8
5.6	5.8	5.9	6.0	6.2	6.3	6.4	6.6	6.7	7.4	8.0	8.7	9.4	10.0	13.4
5.9	6.0	6.1	6.3	6.4	6.6	6.7	6.8	7.0	7.7	8.4	9.1	9.8	10.5	14.0
6.1	6.3	6.4	6.5	6.7	6.8	7.0	7.1	7.3	8.0	8.7	9.5	10.2	10.9	14.5
6.4	6.5	6.7	6.8	7.0	7.1	7.3	7.4	7.6	8.3	9.1	9.8	10.5	11.3	15.1
6.6	6.8	6.9	7.1	7.2	7.4	7.5	7.7	7.9	8.6	9.4	10.2	11.0	11.8	15.7
6.8	7.0	7.2	7.3	7.5	7.7	7.8	8.0	8.1	9.0	9.7	10.6	11.4	12.2	16.3
7.1	7.3	7.4	7.6	7.8	7.9	8.1	8.3	8.4	9.3	10.1	11.0	11.8	12.7	16.9
7.3	7.5	7.7	7.9	8.0	8.2	8.4	8.6	8.7	9.6	10.5	11.3	12.2	13.1	17.5
8.6	8.8	9.0	9.2	9.4	9.6	9.8	10.0	10.2	11.2	12.2	13.2	14.3	15.3	20.4
9.8	10.0	10.2	10.5	10.6	10.9	11.2	11.4	11.6	12.8	14.0	15.1	16.3	17.4	23.3
11.0	11.3	11.5	11.8	12.0	12.3	12.6	12.8	13.1	14.4	15.7	17.0	18.3	19.6	26.2
12.2	12.5	12.8	13.1	13.4	13.7	14.0	14.2	14.5	16.0	17.4	18.9	20.3	21.8	29.1
13.4	13.8	14.1	14.4	14.7	15.0	15.4	15.7	16.0	17.6	19.2	20.8	22.4	24.0	32.0
14.7	15.0	15.4	15.7	16.1	16.4	16.8	17.1	17.5	19.2	20.9	22.7	24.4	26.2	34.9
17.1	17.5	17.9	18.3	18.7	19.1	19.5	20.0	20.4	22.4	24.4	26.5	28.5	30.5	40.7
19.5	20.0	20.5	20.9	21.4	21.9	22.3	22.8	23.3	25.6	27.9	30.2	32.6	34.9	46.5
22.0	22.5	23.0	23.6	24.1	24.6	25.1	25.6	26.2	28.8	31.4	34.0	36.6	39.3	52.3
24.4	25.0	25.6	26.2	26.7	27.3	27.9	28.5	29.1	32.0	34.9	37.8	40.7	43.6	58.1
26.9	27.5	28.1	28.8	29.4	30.1	30.7	31.3	32.0	35.2	38.4	41.6	44.8	48.0	64.0
29.3	30.0	30.7	31.4	32.1	32.8	33.5	34.2	34.9	38.4	41.9	45.3	48.8	52.3	69.8
31.7	32.5	33.2	34.0	34.8	35.5	36.3	37.0	37.8	41.6	45.3	49.1	52.9	56.7	75.6
34.2	35.0	35.8	36.6	37.4	38.2	39.1	39.9	40.7	44.7	48.8	52.9	57.0	61.0	81.4
36.6	37.5	38.4	39.2	40.1	41.0	41.8	42.7	43.6	47.9	52.3	56.7	61.0	65.4	87.2
39.0	40.0	40.9	41.8	42.8	43.7	44.6	45.6	46.5	51.1	55.8	60.4	65.1	69.7	93.0
41.5	42.5	43.4	44.4	45.4	46.4	47.4	48.4	49.4	54.3	59.2	64.2	69.1	74.1	98.7
43.9	44.9	46.0	47.0	48.1	49.1	50.2	51.2	52.3	57.5	62.7	67.9	73.2	78.4	104.5
58.5	59.8	61.2	62.6	64.0	65.4	66.8	68.2	69.6	76.5	83.5	90.5	97.4	104.4	139.2
72.9	74.7	76.4	78.1	79.9	81.6	83.3	85.1	86.8	95.5	104.2	112.9	121.5	130.2	173.6
D 840	D 860	D 880	D 900	D 920	D 940	D 960	D 980	D 1,000	D 1,100	D 1,200	D 1,300	D 1,400	D 1,500	D 2,000

Table XI.—*Differences of altitude*

[Prepared by

Computed from the formula h=D sin a cos a, in which D is the observed distance of the

a	D 100	D 110	D 120	D 130	D 140	D 150	D 160	D 170	D 180	D 190	D 200	D 220	D 240	D 260
° ′														
0 01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
0 02	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
0 03	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
0 04	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
0 05	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4
0 06	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5
0 07	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5
0 08	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.6	0.6
0 09	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7
0 10	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.8
0 11	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.8	0.8
0 12	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.9
0 13	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.9	1.0
0 14	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.9	1.0	1.1
0 15	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.1
0 16	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.2
0 17	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.2	1.3
0 18	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.2	1.3	1.4
0 19	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.3	1.4
0 20	0.6	0.6	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.5
0 21	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.5	1.6
0 22	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.4	1.5	1.7
0 23	0.7	0,7	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.3	1.3	1.5	1.6	1.7
0 24	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.2	1.3	1.3	1.4	1.5	1.7	1.8
0 25	0.7	0.8	0.9	0.9	1.0	1.1	1.2	1.2	1.3	1.4	1.5	1.6	1.7	1.9
0 26	0.8	0.8	0.9	1.0	1.1	1.1	1.2	1.3	1.4	1.4	1.5	1.7	1.8	2.0
0 27	0.8	0.9	0.9	1.0	1.1	1.2	1.3	1.3	1.4	1.5	1.6	1.7	1.9	2.0
0 28	0.8	0.9	1.0	1.1	1.1	1.2	1.3	1.4	1.5	1.5	1.6	1.8	2.0	2.1
0 29	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.9	2.0	2.2
0 30	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.7	1.9	2.1	2.3
0 35	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.2	2.4	2.6
0 40	1.2	1.3	1.4	1.5	1.6	1.7	1.9	2.0	2.1	2.2	2.3	2.6	2.8	3.0
0 45	1.3	1.4	1.6	1.7	1.8	2.0	2.1	2.2	2.4	2.5	2.6	2.9	3.1	3.4
0 50	1.5	1.6	1.7	1.9	2.0	2.2	2.3	2.5	2.6	2.8	2.9	3.2	3.5	3.8
0 55	1.6	1.8	1.9	2.1	2.2	2.4	2.6	2.7	2.9	3.0	3.2	3.5	3.8	4.2
1 00	1.7	1.9	2.1	2.3	2.4	2.6	2.8	3.0	3.1	3.3	3.5	3.8	4.2	4.5
1 10	2.0	2.2	2.4	2.6	2.9	3.1	3.3	3.5	3.7	3.9	4.1	4.5	4.9	5.3
1 20	2.3	2.6	2.8	3.0	3.3	3.5	3.7	4.0	4.2	4.4	4.7	5.1	5.6	6.0
1 30	2.6	2.9	3.1	3.4	3.7	3.9	4.2	4.4	4.7	5.0	5.2	5.8	6.3	6.8
1 40	2.9	3.2	3.5	3.8	4.1	4.4	4.7	4.9	5.2	5.5	5.8	6.4	7.0	7.6
1 50	3.2	3.5	3.8	4.2	4.5	4.8	5.1	5.4	5.8	6.1	6.4	7.0	7.7	8.3
2 00	3.5	3.8	4.2	4.5	4.9	5.2	5.6	5.9	6.3	6.6	7.0	7.7	8.4	9.1
2 10	3.8	4.2	4.5	4.9	5.3	5.7	6.0	6.4	6.8	7.2	7.6	8.3	9.1	9.8
2 20	4.1	4.5	4.9	5.3	5.7	6.1	6.5	6.9	7.3	7.7	8.1	8.9	9.8	10.6
2 30	4.4	4.8	5.2	5.7	6.1	6.5	7.0	7.4	7.8	8.3	8.7	9.6	10.5	11.3
2 40	4.6	5.1	5.6	6.0	6.5	7.0	7.4	7.9	8.4	8.8	9.3	10.2	11.2	12.1
2 50	4.9	5.4	5.9	6.4	6.9	7.4	7.9	8.4	8.9	9.4	9.9	10.9	11.8	12.8
3 00	5.2	5.7	6.3	6.8	7.3	7.8	8.4	8.9	9.4	9.9	10.5	11.5	12.5	13.6
4 00	7.0	7.7	8.4	9.0	9.7	10.4	11.1	11.8	12.5	13.2	13.9	15.3	16.7	18.1
5 00	8.7	9.6	10.4	11.3	12.2	13.0	13.9	14.8	15.6	16.5	17.4	19.1	20.8	22.6
a	D 100	D 110	D 120	D 130	D 140	D 150	D 160	D 170	D 180	D 190	D 200	D 220	D 240	D 260

from telemeter measures—Continued.

R. S. Woodward.]

telemeter staff, a is the angle of elevation or depression, and h is the difference in height.

D 280	D 300	D 320	D 340	D 360	D 380	D 400	D 420	D 440	D 460	D 480	D 500	D 520	D 540
0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3
0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5
0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6
0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.8
0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9
0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.1	1.1
0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3
0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.3	1.4	1.4
0.8	0.9	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.3	1.4	1.5	1.5	1.6
0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.7	1.7
1.0	1.0	1.1	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.9
1.1	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.7	1.8	1.9	2.0	2.0
1.1	1.2	1.3	1.4	1.5	1.5	1.6	1.7	1.8	1.9	2.0	2.0	2.1	2.2
1.2	1.3	1.4	1.5	1.6	1.7	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.0	2.1	2.2	2.3	2.4	2.5
1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7
1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8
1.5	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.7	2.8	2.9	3.0
1.6	1.7	1.9	2.0	2.1	2.2	2.3	2.4	2.6	2.7	2.8	2.9	3.0	3.1
1.7	1.8	2.0	2.1	2.2	2.3	2.4	2.6	2.7	2.8	2.9	3.1	3.2	3.3
1.8	1.9	2.0	2.2	2.3	2.4	2.6	2.7	2.8	2.9	3.1	3.2	3.3	3.5
1.9	2.0	2.1	2.3	2.4	2.5	2.7	2.8	2.9	3.1	3.2	3.3	3.5	3.6
2.0	2.1	2.2	2.4	2.5	2.7	2.8	2.9	3.1	3.2	3.4	3.5	3.6	3.8
2.0	2.2	2.3	2.5	2.6	2.8	2.9	3.1	3.2	3.3	3.5	3.6	3.8	3.9
2.1	2.3	2.4	2.6	2.7	2.9	3.0	3.2	3.3	3.5	3.6	3.8	3.9	4.1
2.2	2.4	2.5	2.7	2.8	3.0	3.1	3.3	3.5	3.6	3.8	3.9	4.1	4.2
2.3	2.4	2.6	2.8	2.9	3.1	2.3	3.4	3.6	3.7	3.9	4.1	4.2	4.4
2.4	2.5	2.7	2.9	3.0	3.2	3.4	3.5	3.7	3.9	4.1	4.2	4.4	4.6
2.4	2.6	2.8	3.0	3.1	3.3	3.5	3.7	3.8	4.0	4.2	4.4	4.5	4.7
2.9	3.1	3.3	3.5	3.7	3.9	4.1	4.3	4.5	4.7	4.9	5.1	5.3	5.5
3.3	3.5	3.7	4.0	4.2	4.4	4.7	4.9	5.1	5.3	5.6	5.8	6.0	6.3
3.7	3.9	4.2	4.5	4.7	5.0	5.2	5.5	5.8	6.0	6.3	6.5	6.8	7.1
4.1	4.4	4.7	4.9	5.2	5.5	5.8	6.1	6.4	6.7	7.0	7.3	7.6	7.9
4.5	4.8	5.1	5.4	5.8	6.1	6.4	6.7	7.0	7.4	7.7	8.0	8.3	8.6
4.9	5.2	5.6	5.9	6.3	6.6	7.0	7.3	7.7	8.0	8.4	8.7	9.1	9.4
5.7	6.1	6.5	6.9	7.3	7.7	8.1	8.6	9.0	9.4	9.8	10.2	10.6	11.0
6.5	7.0	7.4	7.9	8.4	8.8	9.3	9.8	10.2	10.7	11.2	11.6	12.1	12.6
7.3	7.9	8.4	8.9	9.4	9.9	10.5	11.0	11.5	12.0	12.6	13.1	13.6	14.1
8.1	8.7	9.3	9.9	10.5	11.0	11.6	12.2	12.8	13.4	14.0	14.5	15.1	15.7
9.0	9.6	10.2	10.9	11.5	12.2	12.8	13.4	14.1	14.7	15.4	16.0	16.6	17.3
9.8	10.5	11.2	11.9	12.6	13.3	14.0	14.6	15.3	16.0	16.7	17.4	18.1	18.8
10.6	11.3	12.1	12.8	13.6	14.4	15.1	15.9	16.6	17.4	18.1	18.9	19.6	20.4
11.4	12.2	13.0	13.8	14.6	15.5	16.3	17.1	17.9	18.7	19.5	20.3	21.2	22.0
12.2	13.1	13.9	14.8	15.7	16.6	17.4	18.3	19.2	20.0	20.9	21.8	22.7	23.5
13.0	13.9	14.8	15.8	16.7	17.7	18.6	19.5	20.5	21.4	22.3	23.2	24.2	25.1
13.8	14.8	15.8	16.8	17.8	18.8	19.7	20.7	21.7	22.7	23.7	24.7	25.7	26.7
14.6	15.7	16.7	17.8	18.8	19.9	20.9	21.9	23.0	24.0	25.1	26.1	27.2	28.2
19.5	20.9	22.3	23.7	25.1	26.4	27.8	29.2	30.6	32.0	33.4	34.8	36.2	37.6
24.3	26.0	27.8	29.5	31.3	33.0	34.7	36.5	38.2	39.9	41.7	43.4	45.1	46.9
D 280	D 300	D 320	D 340	D 360	D 380	D 400	D 420	D 440	D 460	D 480	D 500	D 520	D 540

TABLE XII.—*For converting wheel revolutions into decimals of a mile.*

[Prepared by S. S. Gannett.]

[Fractions of a mile.]

Circumference of wheel.	.01	.02	.03	.04	.05	.06	.07	.08	.09	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00
	Revolutions.																		
Feet.																			
11.0	5	10	14	19	24	29	34	38	43	48	96	144	192	240	288	336	384	432	480
.1	5	10	14	19	24	29	33	38	43	48	95	143	190	238	286	333	381	428	476
.2	5	9	14	19	24	28	33	38	42	47	94	141	188	235	283	330	377	424	471
.3	5	9	14	19	23	28	33	37	42	47	93	140	187	233	280	327	374	420	467
.4	5	9	14	18	23	28	32	37	42	46	93	139	185	231	278	324	370	417	463
11.5	5	9	14	18	23	28	32	37	41	46	92	138	184	229	275	321	367	413	459
.6	5	9	14	18	23	27	32	37	41	46	91	136	182	227	273	318	364	410	455
.7	5	9	13	18	23	27	32	36	41	45	90	135	180	225	271	316	361	406	451
.8	4	9	13	18	22	27	32	36	40	45	89	134	179	223	268	313	358	402	447
.9	4	9	13	18	22	27	31	35	40	44	89	133	178	222	266	311	355	399	444
12.0	4	9	13	18	22	26	31	35	40	44	88	132	176	220	264	308	352	396	440
.1	4	9	13	17	22	26	31	35	39	44	87	131	174	218	262	305	349	392	436
.2	4	9	13	17	22	26	30	35	39	43	87	130	173	216	260	303	346	390	433
.3	4	9	13	17	21	25	30	34	39	43	86	129	172	214	257	300	343	386	429
.4	4	8	13	17	21	25	30	34	38	43	85	128	170	213	255	298	341	383	426
12.5	4	8	13	17	21	25	30	34	38	42	84	127	169	211	253	295	338	380	422
.6	4	8	13	17	21	25	29	34	38	42	84	126	168	209	251	293	335	377	419
.7	4	8	13	17	21	25	29	33	37	42	83	125	166	208	250	291	333	374	416
.8	4	8	12	16	21	25	29	33	37	41	82	124	165	206	247	288	330	371	412.5
.9	4	8	12	16	20	25	29	33	37	41	82	123	164	204	245	286	327	368	409
13.0	4	8	12	16	20	24	28	33	37	41	81	122	162	203	244	284	325	365	406
.1	4	8	12	16	20	24	28	32	36	40	81	121	161	201	242	282	322	363	403
.2	4	8	12	16	20	24	28	32	36	40	80	120	160	200	240	280	320	360	400
.3	4	8	12	16	20	24	28	32	36	40	79	119	159	198	238	278	318	357	397
.4	4	8	12	16	20	24	28	31	36	39	79	118	158	197	236	276	315	355	394
13.5	4	8	12	16	20	24	27	31	35	39	78	117	156	196	235	274	313	352	391

TABLE XIII.—*Constants.*

π .... $=3.141593$

log. π .... $=0.4971499$

$$\frac{180^\circ}{\pi}=\frac{1}{\text{arc } 1^\circ}=57^\circ.29578=57^\circ\ 17'\ 44''.8: \ \text{log.}=1.7581226$$

$$\frac{10800'}{\pi}=\frac{1}{\text{arc } 1'}=3447'.74677: \ \text{log.}=3.5362739$$

$$r''=\frac{648000''}{\pi}=\frac{1}{\sin 1''}=206264''.80625: \ \text{log.}=5.3144251$$

comp. log. $=4.6855749$

$=$ log. sin $1''$

	Log.
Number of degrees in circumference......	360=2.5563025
Number of minutes in circumference......	21,600=4.3344538
Number of seconds in circumference......	1,296,000=6.1126050
Length of arc of 1 degree..................	.01745329=8.2418774—10
Length of arc of 1 minute..................	.00029089=6.4637261—10
Length of arc of 1 second..................	.000004848=4.6855749—10

Constants of generating ellipse of Clarke's spheroid.

		Log.
a=semimajor axis=20,926,062 feet,		7.3206875
b=semiminor axis=20,855,121 feet,		7.3192127
$e^2=\left(1-\frac{b^2}{a^2}\right)$	= 0.00676866	7.8305030—10
$n=(1-\sqrt{1-e^2})(1+\sqrt{1-e^2})^{-1}$	= 0.00169792	7.2299162—10

Length of the meter in inches according to various authorities.

Inches.	
1 meter=39.370432,	Clarke, 1866-1873.
=39.370790,	Kater, 1818.
=39.368505,	Coast Survey, 1851-1858 (Hassler corrected).
=39.38092,	Hassler, 1832.
=39.36985,	Lake Survey, 1885.
=39.377786,	Theoretical ten-millionth of quadrant (Clarke).
=39.37,	By act of Congress, 1866.

The standard meter has its normal length at 32° F.

The standard yard has its normal length at 62° F.

The value first given is the one generally adopted by scientific men in the United States.

Values adopted in the measurement of an arc of parallel extending from Ireland to the river Ural in Russia, as the exact relative lengths of standards used as the units of measure in the triangulations of England, France, Belgium, Prussia, and Russia.

Standards.	Expressed in terms of the standard yard.	Expressed in inches.	Expressed in lines of the toise.	Expressed in millimeters.
The yard	1.00000000	36.000000	405.34622	914.39180
The toise	2.13151116	76.734402	864.00000	1,949.03632
The meter............................	1.09362311	39.370432	443.29600	1,000.00000

CONVERSION TABLES.

TABLE XIV.—*Meters into yards.*

[Extracted from Appendix No. 6, U. S. Coast and Geodetic Survey Report for 1884].

[1 meter = 1.093623 yards.]

Meters.	Yards.	Meters.	Yards.	Meters.	Yards.	Meters.	Yards.	Meters.	Yards.
100,000	109,362.3								
90,000	98,426.1	9,000	9,842.61	900	984.26	90	98.426	9	9.843
80,000	87,489.8	8,000	8,748.98	800	874.90	80	87.490	8	8.749
70,000	76,553.6	7,000	7,655.36	700	765.54	70	76.554	7	7.655
60,000	65,617.4	6,000	6,561.74	600	656.17	60	65.617	6	6.562
50,000	54,681.2	5,000	5,468.12	500	546.81	50	54.681	5	5.568
40,000	43,744.9	4,000	4,374.49	400	437.45	40	43.745	4	4.374
30,000	32,808.7	3,000	3,280.87	300	328.09	30	32.809	3	3.281
20,000	21,872.5	2,000	2,187.25	200	218.72	20	21.872	2	2.187
10,000	10,936.2	1,000	1,093.62	100	109.36	10	10.936	1	1.094

TABLE XV.—*Yards into meters.*

[1 yard = 0.914392 meter.]

Yards.	Meters.	Yards.	Meters.	Yards.	Meters.	Yards.	Meters.	Yards.	Meters.
100,000	91,439.2								
90,000	82,295.3	9,000	8,229.53	900	822.95	90	82.295	9	8.230
80,000	73,151.3	8,000	7,315.13	800	731.51	80	73.151	8	7.315
70,000	64,007.4	7,000	6,400.74	700	640.07	70	64.007	7	6.401
60,000	54,863.5	6,000	5,486.35	600	548.64	60	54.864	6	5.486
50,000	45,719.6	5,000	4,571.96	500	457.20	50	45.720	5	4.572
40,000	36,575.7	4,000	3,657.57	400	365.76	40	36.576	4	3.658
30,000	27,431.8	3,000	2,743.18	300	274.32	30	27.432	3	2.743
20,000	18,287.8	2,000	1,828.78	200	182.88	20	18.288	2	1.829
10,000	9,143.9	1,000	914.39	100	91.44	10	9.144	1	0.914

TABLE XVI.—*Meters into inches and inches into meters.*

[1 meter = 39.370432 inches. log. = 1.5951702.]

Meters.	Inches.
1	39.37043
2	78.74086
3	118.11130
4	157.48173
5	196.85216
6	236.22259
7	275.59302
8	314.96346
9	354.33389

[1 inch = 0.02539977 meter. log. = 8.4048298.]

Inches.	Meters.
1	0.025400
2	0.050800
3	0.076199
4	0.101599
5	0.126999
6	0.152399
7	0.177798
8	0.203198
9	0.228598

TABLE XVII.—*Meters into statute and nautical miles.*

1 meter = 0.00062138 statute mile.
1 meter = 0.00053959 nautical mile.

Meters.	Statute miles.	Nautical miles.	Meters.	Statute miles.	Nautical miles.	Meters.	Statute miles.	Nautical miles.	Meters.	Statute miles.	Nautical miles.
100,000	62.138	53.959									
90,000	55.924	48.563	9,000	5.592	4.856	900	0.559	0.486	90	0.056	0.049
80,000	49.710	43.167	8,000	4.971	4.317	800	0.497	0.432	80	0.050	0.043
70,000	43.496	37.772	7,000	4.350	3.777	700	0.435	0.378	70	0.043	0.038
60,000	37.283	32.376	6,000	3.728	3.238	600	0.373	0.324	60	0.037	0.032
50,000	31.069	26.980	5,000	3.107	2.698	500	0.311	0.270	50	0.031	0.027
40,000	24.855	21.584	4,000	2.486	2.158	400	0.249	0.216	40	0.025	0.022
30,000	18.641	16.188	3,000	1.864	1.619	300	0.186	0.162	30	0.019	0.016
20,000	12.428	10.792	2,000	1.243	1.079	200	0.124	0.108	20	0.012	0.011
10,000	6.214	5.396	1,000	0.621	0.540	100	0.062	0.054	10	0.006	0.005

TABLE XVIII.—*Statute and nautical miles into meters.*

1 statute mile = 1609.330 meters.
1 nautical mile = 1853.248 meters.

Miles.	Meters in statute miles.	Meters in nautical miles.	Miles.	Meters in statute miles.	Meters in nautical miles.	Miles.	Meters in statute miles.	Meters in nautical miles.	Miles.	Meters in statute miles.	Meters in nautical miles.
100	160,933.0	185,324.8									
90	144,839.7	166,792.3	9	14,483.97	16,679.23	.9	1,448.40	1,667.92	.09	144.84	166.79
80	128.746.4	148,259.8	8	12,874.64	14,825.98	.8	1,287.46	1,482.60	.08	128.75	148.26
70	112,653.1	129,727.4	7	11,265.31	12,972.74	.7	1,126.53	1,297.27	.07	112.65	129.73
60	96,559.8	111,194.9	6	9,655.98	11,119.49	.6	965.60	1,111.95	.06	96.56	111.19
50	80,466.5	92,662.4	5	8,046.65	9,266.24	.5	804.67	926.62	.05	80.47	92.66
40	64,373.2	74,129.9	4	6,437.32	7,412.99	.4	643.73	741.30	.04	64.37	74.13
30	48,279.9	55,597.4	3	4,827.99	5,559.74	.3	482.80	555.97	.03	48.28	55.60
20	32,186.6	37,065.0	2	3,218.66	3,706.50	.2	321.87	370.65	.02	32.19	37.06
10	16,093.3	18,532.5	1	1,609.33	1,853.25	.1	160.93	185.32	.01	16.09	18.53

Meters × 39.370432 = inches, or to log. of meters add 1.5951701
Meters × 3.280869 = feet, or to log. of meters add 0.5159889
Meters × 1.093623 = yards, or to log. of meters add 0.0388676
Meters × 0.000621377 = miles, or to log. of meters add 6.7933550

TABLE XIX.—*For projection of maps of large areas.*

[Extracted from Appendix No. 6, U. S. Coast and Geodetic Survey Report for 1884.]

LENGTHS OF DEGREES OF THE MERIDIAN.

Latitude.	Meters.*	Statute miles.	Latitude.	Meters.*	Statute miles.
°			°		
0	110,567.2	68.704	45	111,130.9	69.054
1	110,567.6	68.704	46	111,150.6	69.066
2	110,568.6	68.705	47	111,170.4	69.079
3	110,570.3	68.706	48	111,190.1	69.091
4	110,572.7	68.708	49	111,209.7	69.103
5	110,575.8	68.710	50	111,229.3	69.115
6	110,579.5	68.712	51	111,248.7	69.127
7	110,583.9	68,715	52	111,268.0	69.139
8	110,589.0	68.718	53	111,287.1	69.151
9	110,594.7	68.721	54	111,306.0	69.163
10	110,601.1	68.725	55	111,324.8	69.175
11	110,608.1	68.730	56	111,343.3	69.186
12	110,615.8	68.734	57	111,361.5	69.197
13	110,624.1	68.739	58	111,379.5	69.209
14	110,633.0	68.744	59	111,397.2	69.220
15	110,642.5	63.751	60	111,414.5	69.230
16	110,652.6	68.757	61	111,431.5	69.241
17	110,663.3	68.764	62	111,448.2	69.251
18	110,674.5	68.771	63	111,464.4	69.261
19	110,686.3	68.778	64	111,480.3	69.271
20	110,698.7	68.786	65	111,495.7	69.281
21	110,711.6	68.794	66	111,510.7	69.290
22	110,725.0	68.802	67	111,525.3	69.299
23	110,738.8	68.811	68	111,539.3	69.308
24	110,753.2	68.820	69	111,552.9	69.316
25	110,768.0	68.829	70	111,565.9	69.324
26	110,783.3	68.839	71	111,578.4	69.332
27	110,799.0	68.848	72	111,590.4	69.340
28	119,815.1	68.858	73	111,601.8	69.347
29	110,831.6	68.869	74	111,612.7	69.354
30	110,848.5	68.879	75	111,622.9	69.360
31	110,865.7	68.890	76	111,632.6	69.366
32	110,883.2	68.901	77	111,641.6	69.372
33	110,901.1	68.912	78	111,650.0	69.377
34	110,919.2	68.923	79	111,657.8	69.382
35	110,937.6	68.935	80	111,664.9	69.386
36	110,956.2	68.946	81	111,671.4	69.390
37	110,975.1	68.958	82	111,677.2	69.394
38	110,994.1	68.969	83	111,682.4	69.397
39	111,013.3	68.981	84	111,686.9	69.400
40	111,032.7	68.993	85	111,690.7	69.402
41	111,052.2	69.006	86	111,693.8	69.404
42	111,071.7	69.018	87	111,696.2	69.405
43	111,091.4	69.030	88	111,697.9	69.407
44	111,111.1	69.042	89	111,699.0	69.407
45	111,130.9	69.054	90	111,699.3	69.407

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*These quantities express the number of meters and statute miles contained within an arc of which the degree of latitude named is the middle; thus, the quantity, 111032.7, opposite latitude 40°, is the number of meters between latitude 39° 30′ and latitude 40° 30′.

TABLE XIX.—*For projection of maps of large areas*—Continued.

[Extracted from Appendix No. 6, U. S. Coast and Geodetic Survey Report for 1884.]

LENGTHS OF DEGREES OF THE PARALLEL.

Latitude.	Meters.	Statute miles.	Latitude.	Meters.	Statute miles.
°			°		
0	111, 321	69. 172	45	78, 849	48. 995
1	1, 304	9. 162	46	7, 466	8. 136
2	1, 253	9. 130	47	6, 058	7. 261
3	1, 169	9. 078	48	4, 628	6. 372
4	1, 051	9. 005	49	3, 174	5. 469
5	110, 900	68. 911	50	71, 698	44. 552
6	0, 715	8. 795	51	70, 200	3. 621
7	0, 497	8. 660	52	68, 680	2. 676
8	0, 245	8. 504	53	7, 140	1. 719
9	109, 959	8. 326	54	5, 578	0. 749
10	109, 641	68. 129	55	63, 996	39. 766
11	9, 289	7. 910	56	2, 395	8. 771
12	8, 904	7. 670	57	60, 774	7. 764
13	8, 486	7. 410	58	59, 135	6. 745
14	8, 036	7. 131	59	7, 478	5. 716
15	107, 553	66. 830	60	55, 802	34. 674
16	7, 036	6. 510	61	4, 110	3. 623
17	6, 487	6. 169	62	2, 400	2. 560
18	5, 906	5. 808	63	50, 675	1. 488
19	5, 294	5. 427	64	48, 934	0. 406
20	104, 649	65. 026	65	47, 177	29. 315
21	3, 972	4. 606	66	5, 407	8. 215
22	3. 264	4. 166	67	3, 622	7. 106
23	2, 524	3. 706	68	1, 823	5. 988
24	1, 754	3. 228	69	0, 012	4. 862
25	100, 952	62. 729	70	38, 188	23. 729
26	100, 119	2. 212	71	6, 353	2. 589
27	99, 257	1. 676	72	4, 506	1. 441
28	8, 364	1. 122	73	2, 648	20. 287
29	7, 441	0. 548	74	0, 781	19. 127
30	96, 488	59. 956	75	28, 903	17. 960
31	5, 506	9. 345	76	7, 017	6. 788
32	4, 495	8. 716	77	5, 123	5. 611
33	3, 455	8. 071	78	3, 220	4. 428
34	2, 387	7. 407	79	1, 311	13. 242
35	91, 290	56. 725	80	19, 394	12. 051
36	90, 166	6. 027	81	17, 472	10. 857
37	89, 014	5. 311	82	15, 545	9. 659
38	7, 835	4. 579	83	13, 612	8. 458
39	6, 629	3. 829	84	11, 675	7. 255
40	85, 396	53. 063	85	9, 735	6. 049
41	4, 137	2. 281	86	7, 792	4. 842
42	2, 853	1. 483	87	5, 846	3. 632
43	1, 543	50. 669	88	3, 898	2. 422
44	80, 208	49. 840	89	1, 949	1. 211
45	78, 849	48. 995	90	0	0. 000

TABLE XIX.—*For projection of maps of large areas*—Continued.

[Extracted from Appendix No. 6, U. S. Coast and Geodetic Survey Report for 1884.]

ARCS OF THE PARALLEL IN METERS.

Latitude.		Value of 1′.	Latitude.		Value of 1′.	Latitude.		Value of 1′.
°	′		°	′		°	′	
24	00	1695.9	33	00	1557.6	42	00	1380.9
	10	3.7		10	4.7		10	77.3
	20	1.5		20	1.7		20	73.7
	30	1689.3		30	48.7		30	70.0
	40	7.0		40	5.8		40	66.4
	50	4.8		50	2.8		50	62.7
25	00	1682.5	34	00	1539.8	43	00	1359.1
	10	80.3		10	6.8		10	55.4
	20	1678.0		20	3.7		20	51.7
	30	5.7		30	0.7		30	48.0
	40	3.3		40	27.6		40	44.3
	50	1.0		50	4.6		50	40.5
26	00	1668.7	35	00	1521.5	44	00	1336.8
	10	6.3		10	18.4		10	33.1
	20	3.9		20	15.3		20	29.3
	30	1.5		30	12.2		30	25.5
	40	1659.1		40	09.1		40	21.7
	50	6.7		50	05.9		50	18.0
27	00	1654.3	36	00	1502.8	45	00	1314.2
	10	51.8		10	1499.6		10	10.3
	20	1649.4		20	6.4		20	06.5
	30	6.9		30	3.2		30	02.7
	40	4.4		40	0.0		40	1298.8
	50	1.9		50	86.8		50	95.0
28	00	1639.4	37	00	1483.6	46	00	1291.0
	10	6.9		10	80.3		10	87.2
	20	4.3		20	77.1		20	83.3
	30	1.8		30	73.8		30	79.4
	40	29.2		40	70.5		40	75.5
	50	6.6		50	67.2		50	71.6
29	00	1624.0	38	00	1463.9	47	00	1267.6
	10	21.4		10	60.6		10	63.7
	20	18.8		20	57.3		20	59.7
	30	6.1		30	53.9		30	55.8
	40	3.5		40	50.6		40	51.8
	50	0.8		50	47.2		50	47.8
30	00	1608.1	39	00	1443.8	48	00	1243.8
	10	5.4		10	40.4		10	39.8
	20	2.7		20	37.0		20	35.8
	30	0.0		30	33.6		30	31.7
	40	1597.3		40	30.2		40	27.7
	50	4.5		50	26.7		50	23.6
31	00	1591.8	40	00	1423.3	49	00	1219.6
	10	89.0		10	19.8		10	15.5
	20	6.2		20	16.3		20	11.4
	30	3.4		30	12.8		30	07.3
	40	0.6		40	09.3		40	03.2
	50	77.8		50	05.8		50	1199.1
32	00	1574.9	41	00	1402.3	50	00	1195.0
	10	72.1		10	1398.8		10	90.8
	20	69.2		20	95.2		20	86.7
	30	6.3		30	91.6		30	82.5
	40	3.4		40	88.1		40	78.4
	50	0.5		50	84.5		50	74.2

TABLE XIX.—*For projections of maps of large areas*—Continued.

[Extracted from Appendix No. 6, U. S. Coast and Geodetic Survey Report for 1884.]

COORDINATES OF CURVATURE.

NATURAL SCALE.—VALUES OF X AND Y IN METERS.

Latitude 24°.			Latitude 25°.			Latitude 26°.			Latitude 27°.		
Longitude.	X	Y	Longitude.	X	Y	Longitude.	X	Y	Longitude.	X	Y
° ′			° ′			° ′			° ′		
1 00	101, 753	361	1 00	100, 951	372	1 00	100, 118	383	1 00	99, 256	393
2 00	203, 500	1, 445	2 00	201, 896	1, 489	2 00	200, 231	1, 532	2 00	198, 505	1, 573
3 00	305, 237	3, 250	3 00	302, 831	3, 351	3 00	300, 332	3, 447	3 00	297, 742	3, 539
4 00	406, 959	5, 778	4 00	403, 749	5, 957	4 00	400, 416	6, 128	4 00	396, 960	6, 291
5 00	508, 660	9, 028	5 00	504, 645	9, 307	5 00	500, 476	9, 574	5 00	496, 154	9, 829
6 00	610, 336	13, 001	6 00	605, 514	13, 401	6 00	600, 506	13, 786	6 00	595, 316	14, 154
7 00	711, 981	17, 695	7 00	706, 349	18, 239	7 00	700, 501	18, 763	7 00	694, 440	19, 264
8 00	813, 590	23, 109	8 00	807, 146	23, 821	8 00	800, 456	24, 505	8 00	793, 522	25, 159
9 00	915, 159	29, 245	9 00	907, 899	30, 146	9 00	900, 364	31, 011	9 00	892, 554	31, 839
10 00	1, 016, 681	36, 102	10 00	1, 008, 603	37, 215	10 00	1, 000, 218	38, 282	10 00	991, 529	39, 303
11 00	1, 118, 152	43, 679	11 00	1, 109, 252	45, 026	11 00	1, 100, 015	46, 316	11 00	1, 090, 442	47, 551
12 00	1, 219, 566	51, 977	12 00	1, 209, 841	53, 578	12 00	1, 199, 747	55, 114	12 00	1, 189, 287	56, 583
13 00	1, 320, 919	60, 994	13 00	1, 310, 364	62, 873	13 00	1, 299, 409	64, 675	13 00	1, 288, 057	66, 398
14 00	1, 422, 205	70, 731	14 00	1, 410, 815	72, 909	14 00	1, 398, 994	74, 998	14 00	1, 386, 746	76, 995
15 00	1, 523, 420	81, 186	15 00	1, 511, 190	83, 685	15 00	1, 498, 498	86, 082	15 00	1, 485, 348	88, 374
16 00	1, 624, 558	92, 360	16 00	1, 611, 483	95, 202	16 00	1, 597, 914	97, 928	16 00	1, 583, 857	100, 534
17 00	1, 725, 614	104, 251	17 00	1, 711, 688	107, 458	17 00	1, 697, 237	110, 534	17 00	1, 682, 267	113, 474
18 00	1, 826, 583	116, 859	18 00	1, 811, 800	120, 453	18 00	1, 796, 460	123, 899	18 00	1, 780, 570	127, 193
19 00	1, 927, 460	130, 184	19 00	1, 911, 813	134, 186	19 00	1, 895, 578	138, 023	19 00	1, 878, 762	141, 690
20 00	2, 028, 240	144, 225	20 00	2, 011, 722	148, 656	20 00	1, 994, 585	152, 905	20 00	1, 976, 836	156, 966
21 00	2, 128, 918	158, 981	21 00	2, 111, 522	163, 862	21 00	2, 093, 475	168, 544	21 00	2, 074, 786	173, 018
22 00	2, 229, 488	174, 451	22 00	2, 211, 207	179, 805	22 00	2, 192, 243	184, 939	22 00	2, 172, 606	189. 845
23 00	2, 329, 946	190, 634	23 00	2, 310, 771	196, 482	23 00	2, 290, 882	202, 089	23 00	2, 270, 289	207, 447
24 00	2, 430, 287	207, 530	24 00	2, 410, 210	213, 894	24 00	2, 389, 387	219, 993	24 00	2, 367, 830	225, 823
25 00	2, 530, 505	225, 138	25 00	2, 509, 518	232, 038	25 00	2, 487, 753	238, 650	25 00	2, 465, 222	244, 970
26 00	2, 630, 596	243, 458	26 00	2, 608, 689	250, 914	26 00	2, 585, 973	258, 061	26 00	2, 562, 459	264, 889
27 00	2, 730, 554	262, 487	27 00	2, 707, 718	270, 521	27 00	2, 684, 042	278, 222	27 00	2, 659, 535	285, 577
28 00	2, 830, 374	282, 225	28 00	2, 806, 600	290, 859	28 00	2, 781, 953	299, 132	28 00	2, 756, 445	307, 035
29 00	2, 930, 052	302, 671	29 00	2, 905, 329	311, 925	29 00	2, 879, 702	320, 788	29 00	2, 853, 181	329, 259
30 00	3, 029, 582	323, 825	30 00	3, 003, 900	333, 718	30 00	2, 977, 281	343, 197	30 00	2, 949, 739	352, 249

TABLE XIX.—*For projections of maps of large areas*—Continued.

[Extracted from Appendix No. 6, U. S. Coast and Geodetic Survey Report for 1884.]

COORDINATES OF CURVATURE.

NATURAL SCALE.—VALUES OF X AND Y IN METERS.

Latitude 28°.			Latitude 29°.			Latitude 30°.			Latitude 31°.		
Longitude.	X	Y	Longitude.	X	Y	Longitude.	X	Y	Longitude.	X	Y
° ′			° ′			° ′			° ′		
1 00	98, 363	403	1 00	97, 439	412	1 00	96, 487	421	1 00	95, 505	429
2 00	196, 719	1, 612	2 00	194, 872	1, 649	2 00	192, 967	1, 684	2 00	191, 002	1, 717
3 00	295, 062	3, 627	3 00	292, 291	3, 710	3 00	289, 432	3, 789	3 00	286, 484	3, 863
4 00	393, 385	6, 447	4 00	389, 689	6, 595	4 00	385, 875	6, 735	4 00	381, 943	6, 867
5 00	491, 682	10, 073	5 00	487, 059	10, 305	5 00	482. 288	10, 523	5 00	477, 371	10, 729
6 00	589, 945	14, 505	6 00	584, 394	14, 838	6 00	578, 665	15, 153	6 00	572, 760	15, 450
7 00	688, 168	19, 741	7 00	681, 687	20, 194	7 00	674, 998	20, 623	7 00	668, 103	21, 027
8 00	786, 347	25, 782	8 00	778, 931	26, 374	8 00	771, 279	26, 934	8 00	763, 392	27, 461
9 00	884, 472	32, 627	9 00	876, 120	33, 376	9 00	867, 602	34, 084	9 00	858, 619	34, 751
10 00	982, 537	40, 276	10 00	973, 246	41, 199	10 00	963, 658	42, 074	10 00	953, 777	42, 897
11 00	1, 080, 537	48, 728	11 00	1, 070, 302	49, 845	11 00	1, 059, 741	50, 903	11 00	1, 048, 858	51, 898
12 00	1, 178, 464	57, 983	12 00	1, 167, 282	59, 313	12 00	1, 155, 744	60, 570	12 00	1, 143, 854	61, 753
13 00	1, 276, 312	68, 040	13 00	1, 264, 178	69, 601	13 00	1, 251, 658	71, 074	13 00	1, 238, 758	72, 462
14 00	1, 374, 075	78, 899	14 00	1, 360, 983	80. 706	14 00	1, 347, 477	82, 415	14 00	1, 333, 561	84, 024
15 00	1, 471, 745	90, 558	15 00	1, 457, 691	92, 631	15 00	1, 443, 193	94, 591	15 00	1, 428, 257	96, 437
16 00	1, 569, 315	103, 017	16 00	1, 554, 295	105, 375	16 00	1, 538, 800	107, 603	16 00	1, 522, 837	109, 701
17 00	1, 666, 781	116, 275	17 00	1, 650, 787	118, 935	17 00	1, 634, 290	121, 449	17 00	1, 617, 294	123, 815
18 00	1, 764, 135	130, 331	18 00	1, 747, 161	133, 311	18 00	1, 729, 654	136, 127	18 00	1, 711, 621	138, 777
19 00	1, 861, 371	145, 185	19 00	1, 843, 410	148, 502	19 00	1, 824, 887	151, 637	19 00	1, 805, 810	154, 586
20 00	1, 958, 481	160, 835	20 00	1, 939, 527	164, 506	20 00	1, 919, 982	167, 977	20 00	1, 899, 852	171, 241
21 00	2, 055, 460	177, 280	21 00	2, 035, 505	181, 324	21 00	2, 014, 930	185, 147	21 00	1, 993, 740	188, 741
22 00	2, 152, 302	194, 518	22 00	2, 131, 338	198, 953	22 00	2, 109, 725	203, 143	22 00	2, 087, 468	207, 085
23 00	2, 248, 998	212, 550	23 00	2, 227, 020	217, 392	23 00	2, 204, 359	221, 966	23 00	2, 181, 027	226, 270
24 00	2, 345, 544	231, 374	24 00	2, 322, 539	236, 640	24 00	2, 298, 825	241, 616	24 00	2, 274, 411	246, 295
25 00	2, 441, 932	250, 988	25 00	2, 417, 893	256, 695	25 00	2, 393, 116	262, 089	25 00	2, 367, 610	267, 159
26 00	2, 538, 156	271, 391	26 00	2, 513, 074	277, 558	26 00	2, 487, 224	283, 383	26 00	2, 460, 618	288, 860
27 00	2, 634, 210	292, 582	27 00	2, 608, 075	299, 224	27 00	2, 581, 144	305, 498	27 00	2, 553, 427	311, 396
28 00	2, 730, 087	314, 559	28 00	2, 702, 890	321, 094	28 00	2, 674, 867	328, 432	28 00	2, 646, 029	334, 765
29 00	2, 825, 779	337, 321	29 00	2, 797, 511	344, 904	29 00	2, 768, 385	352, 183	29 00	2, 738, 418	358, 966
30 00	2, 921, 284	360, 866	30 00	2, 891, 931	369, 036	30 00	2, 861, 694	376, 749	30 00	2, 830, 585	383, 997

TABLE XIX.—*For projections of maps of large areas*—Continued.

[Extracted from Appendix No. 6, U. S. Coast and Geodetic Survey Report for 1884.]

COORDINATES OF CURVATURE.

NATURAL SCALE.—VALUES OF X AND Y IN METERS.

Latitude 32°.			Latitude 33°.			Latitude 34°.			Latitude 35°.		
Longitude.	X	Y	Longitude.	X	Y	Longitude.	X	Y	Longitude.	X	Y
° ′			° ′			° ′			° ′		
1 00	94,494	437	1 00	93,454	444	1 00	92,385	451	1 00	91,289	457
2 00	188,980	1,748	2 00	186,899	1,777	2 00	184,762	1,803	2 00	182,568	1,828
3 00	283,449	3,933	3 00	280,328	3,997	3 00	277,121	4,057	3 00	273,830	4,112
4 00	377,894	6,991	4 00	373,731	7,106	4 00	369,454	7,212	4 00	365,064	7,310
5 00	472,307	10,922	5 00	467,100	11,102	5 00	461,751	11,268	5 00	456,261	11,421
6 00	566.680	15,727	6 00	560,428	15,986	6 00	554,004	16,225	6 00	547,412	16,445
7 00	661,004	21,404	7 00	653,704	21,757	7 00	646,205	22,082	7 00	638,509	22,381
8 00	755,272	27,954	8 00	746,922	28,414	8 00	738,344	28,839	8 00	729,542	29,229
9 00	849,475	35,375	9 00	840,072	35,957	9 00	830,413	36,494	9 00	820,501	36,987
10 00	943,605	43,667	10 00	1,933,146	44,385	10 00	922,403	45,048	10 00	911,379	45,656
11 00	1,037,655	52,829	11 00	1,026,136	53,697	11 00	1,014,305	54,499	11 00	1,002,165	55,234
12 00	1,131,616	62,861	12 00	1,119,033	63,893	12 00	1,106,110	64,846	12 00	1,092,850	65,721
13 00	1,225,480	73,761	13 00	1,211,829	74,971	13 00	1,197,809	76,089	13 00	1,183,426	77,115
14 00	1,319,239	85,529	14 00	1,304,515	86,931	14 00	1,289,395	88,227	14 00	1,273,884	89,415
15 00	1,412,885	98,164	15 00	1,397,083	99,771	15 00	1,380,858	101,258	15 00	1,364,214	102,619
16 00	1,506,411	111,664	16 00	1,489,526	113,491	16 00	1,472,190	115,180	16 00	1,454,407	116,728
17 00	1,599,808	126,029	17 00	1,581,834	128,089	17 00	1,563,381	129,993	17 00	1,544,454	131,738
18 00	1,693,067	141,256	18 00	1,673,998	143,564	18 00	1,654,423	145,696	18 00	1,634,347	147,050
19 00	1,786,182	157,346	19 00	1,766,011	159,914	19 00	1,745,308	162,287	19 00	1,724,076	164,460
20 00	1,879,144	174,296	20 00	1,857,860	177,138	20 00	1,836,026	179,763	20 00	1,813,632	182,168
21 00	1,971,946	192,105	21 00	1,949,553	195,234	21 00	1,926,569	198,124	21 00	1,903,006	200,772
22 00	2,064,579	210,772	22 00	2,041,062	214,201	22 00	2,016,929	217,368	22 00	1,992,190	220,268
23 00	2,157,035	230,295	23 00	2,132,387	234,037	23 00	2,107,097	237,493	23 00	2,081,174	240,657
24 00	2,249,305	250,672	24 00	2,223,521	254,740	24 00	2,197,065	258,407	24 00	2,169,940	261,936
25 00	2,341,385	271,901	25 00	2,314,453	276,309	25 00	2,286 823	280,378	25 00	2,258,507	284,102
26 00	2,433,264	293,981	26 00	2,405,175	298,741	26 00	2,376,363	303,134	26 00	2.346,838	307,154
27 00	2,524,935	316,910	27 00	2.495,680	322,034	27 00	2,465,677	326,763	27 00	2,434,934	331,089
28 00	2,616,390	340,686	28 00	2,585,961	346.187	28 00	2,554,756	351,262	28 00	2,522,787	355,905
29 00	2,707,621	365,307	29 00	2,676,007	371,197	29 00	2,643,591	376,629	29 00	2,610,386	381,598
30 00	2,798,621	390,770	30 00	2,765,812	397,061	30 00	2,732,175	402,863	30 00	2,697,724	408,168

TABLE XIX.—*For projections of maps of large areas*—Continued.

[Extracted from Appendix No. 6, U. S. Coast and Geodetic Survey Report for 1884.]

COORDINATES OF CURVATURE.

NATURAL SCALE.—VALUES OF X AND Y METERS.											
Latitude 36°.			Latitude 37°.			Latitude 38°.			Latitude 39°.		
Longitude.	X	Y	Longitude.	X	Y	Longitude.	X	Y	Longitude.	X	Y
° ′			° ′			° ′			° ′		
1 00	90, 164	462	1 00	89, 012	467	1 00	87, 833	472	1 00	86, 627	476
2 00	180, 319	1, 850	2 00	178, 015	1, 870	2 00	175, 656	1, 888	2 00	173, 243	1, 903
3 00	270, 455	4, 162	3 00	266, 997	4, 207	3 00	263, 458	4, 247	3 00	259, 839	4, 281
4 00	360, 562	7, 399	4 00	355, 951	7, 479	4 00	351, 230	7, 549	4 00	346, 403	7, 611
5 00	450, 631	11, 560	5 00	444, 865	11, 685	5 00	438, 962	11, 795	5 00	432, 925	11, 891
6 00	540, 653	16, 645	6 00	533, 730	16, 824	6 00	526, 643	16, 983	6 00	519, 396	17, 121
7 00	630, 618	22, 652	7 00	622, 536	22, 896	7 00	614, 263	23, 112	7 00	605, 803	23, 300
8 00	720, 517	29, 583	8 00	711, 273	29, 901	8 00	701, 812	30, 183	8 00	692, 138	30, 428
9 00	810, 340	37, 435	9 00	799, 932	37, 838	9 00	789, 280	38, 195	9 00	778, 388	38, 504
10 00	900, 078	46, 209	10 00	888, 503	46, 706	10 00	876, 657	47, 145	10 00	864, 545	47, 527
11 00	989, 720	55, 903	11 00	976, 975	56, 503	11 00	963, 933	57, 034	11 00	950, 598	57, 496
12 00	1, 079, 259	66, 515	12 00	1, 065, 340	67, 229	12 00	1, 051, 098	67, 860	12 00	1, 036, 536	68, 409
13 00	1, 168, 684	78, 046	13 00	1, 153, 587	78, 882	13 00	1, 138, 141	79, 622	13 00	1, 122, 349	80, 266
14 00	1, 257, 987	90, 494	14 00	1, 241, 707	91, 462	14 00	1, 225, 053	92, 319	14 00	1, 208, 027	93, 064
15 00	1, 347, 156	103, 856	15 00	1, 329, 690	104, 967	15 00	1, 311, 823	105, 949	15 00	1, 293, 559	106, 802
16 00	1, 436, 184	118, 133	16 00	1, 417, 526	119, 395	16 00	1, 398, 441	120, 511	16 00	1, 378, 934	121, 479
17 00	1, 525, 061	133, 323	17 00	1, 505, 206	134, 745	17 00	1, 484, 899	136, 002	17 00	1, 464, 144	137, 093
18 00	1, 613, 777	149, 423	18 00	1, 592, 721	151, 015	18 00	1, 571, 185	152, 421	18 00	1, 549, 177	153, 642
19 00	1, 702, 324	166, 433	19 00	1, 680, 059	168, 203	19 00	1, 657, 289	169, 767	19 00	1, 634, 023	171, 124
20 00	1, 790, 691	184, 350	20 00	1, 767, 211	186, 307	20 00	1, 743, 202	188, 037	20 00	1, 718, 671	189, 537
21 00	1, 878, 870	203, 173	21 00	1, 854, 169	205, 326	21 00	1, 828, 914	207, 229	21 00	1, 803, 113	208, 878
22 00	1, 966, 851	222, 899	22 00	1, 940, 922	225, 258	22 00	1, 914, 415	227, 341	22 00	1, 887, 337	229, 146
23 00	2, 054, 625	243, 527	23 00	2, 027, 462	246, 099	23 00	1, 999, 694	248, 370	23 00	1, 971, 333	250, 337
24 00	2, 142, 183	265, 055	24 00	2, 113, 777	267, 849	24 00	2, 084, 743	270, 315	24 00	2, 055, 091	272, 450
25 00	2, 229, 516	287, 479	25 00	2, 199, 860	290, 503	25 00	2, 169, 551	293, 172	25 00	2, 138, 602	295, 481
26 00	2, 316, 613	310, 798	26 00	2, 285, 699	314, 061	26 00	2, 254, 109	316, 939	26 00	2, 221, 854	319. 429
27 00	2, 403, 467	335, 009	27 00	2, 371, 287	338, 519	27 00	2, 338, 406	341, 613	27 00	2, 304, 838	344, 289
28 00	2, 490, 068	360, 111	28 00	2, 456. 612	363, 874	28 00	2, 422, 433	367, 192	28 00	2, 387, 545	370, 059
29 00	2, 576, 407	386, 099	29 00	2, 541, 667	390, 125	29 00	2, 506, 181	393, 672	29 00	2, 469, 963	396, 736
30 00	2, 662, 475	412, 971	30 00	2, 626, 441	417, 267	30 00	2, 589, 639	421, 050	30 00	2, 552, 084	424, 317

TABLE XIX.—*For projections of maps of large areas*—Continued.

[Extracted from Appendix No. 6, U. S. Coast and Geodetic Survey Report for 1884.]

COORDINATES OF CURVATURE.

NATURAL SCALE.—VALUES OF X AND Y IN METERS,

Latitude 40°.			Latitude 41°.			Latitude 42°.			Latitude 43°.		
Longitude.	X	Y	Longitude.	X	Y	Longitude.	X	Y	Longitude.	X	Y
° ′			° ′			° ′			° ′		
1 00	85, 394	479	1 00	84, 136	482	1 00	82, 851	484	1 00	81, 541	485
2 00	170, 778	1, 916	2 00	168, 260	1, 927	2 00	165, 691	1, 935	2 00	163, 071	1, 941
3 00	256, 140	4, 311	3 00	252, 363	4, 335	3 00	248, 508	4, 354	3 00	244, 578	4, 367
4 00	341, 470	7, 663	4 00	336, 432	7, 706	4 00	331, 292	7, 739	4 00	326, 050	7, 763
5 00	426, 757	11, 972	5 00	420, 457	12, 039	5 00	414, 030	12, 092	5 00	407, 476	12, 129
6 00	511, 990	17, 238	6 00	504, 428	17, 335	6 00	496, 712	17, 410	6 00	488, 844	17, 464
7 00	597, 158	23, 460	7 00	588, 332	23, 591	7 00	579, 325	23, 693	7 00	570, 143	23, 766
8 00	682, 252	30, 637	8 00	672, 159	30, 807	8 00	661, 861	30, 941	8 00	651, 361	31, 036
9 00	767, 260	38, 768	9 00	755, 897	38, 983	9 00	744, 395	39, 152	9 00	732, 486	39, 272
10 00	852, 171	47, 852	10 00	839, 537	48, 118	10 00	826, 648	48, 325	10 00	813, 508	48, 474
11 00	936, 975	57, 888	11 00	923, 067	58, 209	11 00	908, 879	58, 459	11 00	894, 415	58, 639
12 00	1, 021, 661	68, 875	12 00	1, 006, 475	69, 256	12 00	990, 985	69, 553	12 00	975, 195	69, 766
13 00	1, 106, 218	80, 811	13 00	1, 089, 752	81, 258	13 00	1, 072, 956	81, 605	13 00	1, 055, 837	81, 854
14 00	1, 190, 636	93, 695	14 00	1, 172, 886	94, 212	14 00	1, 154, 781	94, 614	14 00	1, 136, 329	94, 901
15 00	1, 274, 904	107, 525	15 00	1, 255, 866	108, 117	15 00	1, 236, 449	108, 577	15 00	1, 216, 661	108, 905
16 00	1, 359. 012	122, 300	16 00	1, 338, 681	122, 971	16 00	1, 317, 948	123, 493	16 00	1, 296, 820	123, 864
17 00	1, 442, 949	138, 017	17 00	1, 421, 321	138, 773	17 00	1, 399, 267	139, 360	17 00	1, 376, 795	139, 777
18 00	1, 526, 704	154, 675	18 00	1, 503, 775	155, 520	18 00	1, 480, 395	156, 175	18 00	1, 456, 575	156, 640
19 00	1, 610, 267	172, 272	19 00	1, 586, 031	173, 210	19 00	1, 561, 321	173, 937	19 00	1, 536, 148	174, 451
20 00	1, 693. 628	190, 805	20 00	1, 668, 079	191, 841	20 00	1, 642, 035	192, 642	20 00	1, 615, 505	193, 209
21 00	1, 776, 775	210, 272	21 00	1, 749, 909	211, 409	21 00	1, 722, 524	212, 289	21 00	1, 694, 632	212, 909
22 00	1, 859, 698	230, 671	22 00	1, 831, 509	231, 914	22 00	1, 802, 779	232, 874	22 00	1, 773, 519	233, 551
23 00	1, 942, 387	251, 998	23 00	1, 912, 869	253, 352	23 00	1, 882, 788	254, 396	23 00	1, 852, 155	255, 129
24 00	2, 024, 833	274, 252	24 00	1, 993, 978	275, 719	24 00	1, 962, 540	276, 850	24 00	1, 930, 528	277, 642
25 00	2, 107, 023	297, 430	25 00	2, 074, 826	299, 014	25 00	2, 042, 024	300, 234	25 00	2, 008, 628	301, 087
26 00	2, 188, 948	321, 528	26 00	2, 155, 402	323, 233	26 00	2, 121 230	324, 544	26 00	2, 086, 443	325, 459
27 00	2, 270, 597	346, 543	27 00	2, 235, 695	348, 374	27 00	2, 200, 146	349, 778	27 00	2, 163, 963	350, 750
28 00	2, 351, 961	372, 473	28 00	2, 315, 695	374, 432	28 00	2, 278, 762	375, 932	28 00	2, 241, 176	376, 974
29 00	2, 433, 029	399, 314	29 00	2, 395, 392	401, 404	29 00	2, 357, 067	403, 002	29 00	2, 318, 071	404, 109
30 00	2, 513, 790	427, 063	30 00	2, 474, 774	429, 287	30 00	2, 435, 052	430, 985	30 00	2, 394, 639	432, 157

TABLE XIX.—*For projections of maps of large areas*—Continued.

[Extracted from Appendix No. 6, U. S. Coast and Geodetic Survey Report for 1884.]

COORDINATES OF CURVATURE.

NATURAL SCALE.—VALUES OF X AND Y IN METERS.

Latitude 44°.				Latitude 45°.				Latitude 46°.				Latitude 47°.			
Longitude.		X	Y	Longitude.		X	Y	Longitude.		X	Y	Longitude.		X	Y
°	′			°	′			°	′			°	′		
1	00	80, 206	486	1	00	78, 847	486	1	00	77, 464	486	1	00	76, 056	485
2	00	160, 401	1, 945	2	00	157, 682	1, 946	2	00	154, 915	1, 945	2	00	152, 100	1, 942
3	00	240, 572	4, 375	3	00	236, 493	4, 378	3	00	232, 342	4, 376	3	00	228, 119	4, 368
4	00	320, 708	7, 778	4	00	315, 269	7, 783	4	00	309, 732	7, 779	4	00	304, 101	7, 765
5	00	400, 797	12, 152	5	00	393, 996	12, 160	5	00	387, 074	12, 153	5	00	380, 034	12, 131
6	00	480, 82[illegible]	17, 496	6	00	472, 663	17, 508	6	00	464, 354	17, 498	6	00	455, 904	17, 467
7	00	560, 786	23, 811	7	00	551, 258	23, 826	7	00	541, 562	23, 813	7	00	531, 700	23, 770
8	00	640, 662	31, 094	8	00	629, 769	31, 114	8	00	618, 684	31, 096	8	00	607, 410	31, 040
9	00	720, 445	39, 345	9	00	708, 184	39, 370	9	00	695, 708	39, 347	9	00	683, 020	39, 276
10	00	800, 122	48, 563	10	00	786, 492	48, 594	10	00	772, 623	48, 565	10	00	758, 520	48, 477
11	00	879, 681	58, 746	11	00	864, 679	58, 782	11	00	849, 416	58, 747	11	00	833, 895	58, 640
12	00	959, 110	69, 893	12	00	942, 735	69, 936	12	00	926, 075	69, 893	12	00	909, 135	69, 765
13	00	1, 038, 399	82, 002	13	00	1, 020, 647	82, 051	13	00	1, 002, 588	82, 000	13	00	984, 227	81, 849
14	00	1, 117, 535	95, 072	14	00	1, 098, 404	95, 127	14	00	1, 078, 943	95, 067	14	00	1, 059, 158	94, 890
15	00	1, 196, 507	109, 100	15	00	1, 175, 994	109, 162	15	00	1, 155, 128	109, 091	15	00	1, 133, 917	108, 887
16	00	1, 275, 303	124, 084	16	00	1, 253, 404	124, 153	16	00	1, 231, 131	124, 071	16	00	1, 208, 491	123, 837
17	00	1, 353, 911	140, 023	17	00	1, 330, 624	140, 099	17	00	1, 306, 940	140, 003	17	00	1, 282, 868	139, 738
18	00	1, 432, 320	156, 913	18	00	1, 407, 640	156, 996	18	00	1, 382, 543	156, 887	18	00	1, 357, 036	156, 587
19	00	1, 510, 519	174, 753	19	00	1, 484, 443	174, 842	19	00	1, 457, 928	174, 718	19	00	1, 430, 984	174, 381
20	00	1, 588, 496	193, 540	20	00	1, 561, 019	193, 635	20	00	1, 533, 083	193, 494	20	00	1, 504, 697	193, 118
21	00	1, 666, 240	213, 270	21	00	1, 637, 358	213, 371	21	00	1, 607, 997	213, 212	21	00	1, 578, 166	212, 793
22	00	1, 743, 738	233, 942	22	00	1, 713, 447	234, 048	22	00	1. 682, 657	233, 869	22	00	1, 651, 377	233, 405
23	00	1, 820, 980	255, 552	23	00	1, 789, 276	255, 663	23	00	1, 757, 052	255, 462	23	00	1, 724, 320	254, 950
24	00	1, 897, 955	278, 096	24	00	1, 864, 831	278, 211	24	00	1, 831, 170	277, 987	24	00	1, 796, 982	277, 425
25	00	1, 974, 650	301, 572	25	00	1, 940, 103	301, 690	25	00	1, 904, 999	301, 441	25	00	1, 869, 351	300, 824
26	00	2, 051, 055	325, 977	26	00	2, 015, 079	326, 097	26	00	1, 978, 528	325, 820	26	00	1, 941, 415	325, 146
27	00	2, 127, 159	351, 306	27	00	2, 089, 749	351, 427	27	00	2, 051, 745	351, 120	27	00	2, 013, 163	350, 386
28	00	2, 202, 950	377, 555	28	00	2, 164, 100	377, 676	28	00	2, 124, 639	377, 337	38	00	2, 084, 583	376, 539
29	00	2, 278, 417	404, 722	29	00	2, 238, 121	404, 841	29	00	2, 197, 197	404, 468	29	00	2, 155, 663	403, 602
30	00	2, 353, 550	432, 801	30	00	2, 311, 802	432, 918	30	00	2, 269, 410	432, 507	30	00	2, 226, 392	431, 569

TABLE XIX.—*For projections of maps of large areas*—Continued.

[Extracted from Appendix No. 6, U. S. Coast and Geodetic Survey Report for 1884.]

COORDINATES OF CURVATURE.

NATURAL SCALE.—VALUES OF X AND Y IN METERS.

Latitude 48°.			Latitude 49°.			Latitude 50°.		
Longitude.	X	Y	Longitude.	X	Y	Longitude.	X	Y
° ′			° ′			° ′		
1 00	74,626	484	1 00	73,172	482	1 00	71,696	479
2 00	149,239	1,936	2 00	146,331	1,928	2 00	143,379	1,917
3 00	223,827	4,355	3 00	219,465	4,337	3 00	215,037	4,313
4 00	298,377	7,742	4 00	292,561	7,709	4 00	286,656	7,667
5 00	372,877	12,095	5 00	365,606	12,044	5 00	358,224	11,978
6 00	447,314	17,414	6 00	438,588	17.340	6 00	429,727	17,246
7 00	521,677	23,698	7 00	511,493	23,598	7 00	501,154	23,469
8 00	595,951	30,946	8 00	584,310	30,815	8 00	572,492	30,646
9 00	670,125	39,157	9 00	657,026	38,991	9 00	643,727	38,777
10 00	744,186	48,329	10 00	729,627	48,123	10 00	714,847	47,859
11 00	818,123	58,461	11 00	802,102	58,212	11 00	785,839	57,891
12 00	891,921	69,552	12 00	874,438	69,254	12 00	856,691	68,872
13 00	965,570	81,598	13 00	946,622	81,248	13 00	927,389	80,798
14 00	1,039,056	94,598	14 00	1,018,642	94,191	14 00	997,922	93,669
15 00	1,112,367	108,551	15 00	1,090,485	108,082	15 00	1,068,277	107,482
16 00	1,185,491	123,453	16 00	1,162,138	122,918	16 00	1,138,440	122,234
17 00	1,258,416	139,302	17 00	1,233,591	138,697	17 00	1,208,400	137,923
18 00	1,331,129	156,096	18 00	1,304,829	155,416	18 00	1,278,144	154,546
19 00	1,403,618	173,832	19 00	1,375,840	173,071	19 00	1,347,660	172,099
20 00	1,475,871	192,506	20 00	1,446,613	191,660	20 00	1,416,934	190,581
21 00	1,547,876	212,116	21 00	1,517,135	211,180	21 00	1,485,956	209,987
22 00	1,619,620	232,658	22 00	1,587,394	231,627	22 00	1,554,711	230,314
23 00	1,691,091	254,128	23 00	1,657,378	252,998	23 00	1,623,189	251,559
24 00	1,762,279	276,524	24 00	1,727,073	275,288	24 00	1,691,377	273,717
25 00	1,833,170	299,842	25 00	1,796,470	298,495	25 00	1,759,262	296,785
26 00	1,903,752	324,077	26 00	1,865,554	322,614	26 00	1,826,833	320,758
27 00	1,974,015	349,225	27 00	1,934,315	347,640	27 00	1,894,077	345,633
28 00	2,043,945	375,283	28 00	2,002,740	373,570	28 00	1,960,983	371,404
29 00	2,113,531	402,245	29 00	2,070,817	400,399	29 00	2,027,538	398,068
30 00	2,182,762	430,107	30 00	2,138,536	428,123	30 00	2,093,731	425,619

TABLE XX.—*Coordinates for projection of maps. Scale* $\frac{1}{250000}$.

[Prepared by R. S. Woodward.]

Latitude of parallel.	Meridional distances from even degree parallels.	Coordinates of developed parallel for—							
		15′ longitude.		30′ longitude.		45′ longitude.		1° longitude.	
		x	y	x	y	x	y	x	y
° ′	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
25 00	....	3.974	.004	7.949	.015	11.923	.033	15.898	.059
15	4.361	3.966	.004	7.933	.015	11.899	.033	15.865	.059
30	8.722	3.958	.004	7.916	.015	11.874	.033	15.832	.059
45	13.083	3.950	.004	7.900	.015	11.850	.034	15.800	.060
26 00	17.444	3.942	.004	7.883	.015	11.825	.034	15.767	.060
15	4.362	3.933	.004	7.866	.015	11.800	.034	15.733	.061
30	8.723	3.925	.004	7.849	.015	11.774	.034	15.699	.061
45	13.085	3.916	.004	7.833	.015	11.749	.035	15.665	.061
27 00	17.446	3.908	.004	7.816	.015	11.723	.035	15.631	.062
15	4.362	3.899	.004	7.798	.016	11.697	.035	15.596	.062
30	8.724	3.890	.004	7.780	.016	11.671	.035	15.561	.063
45	13.087	3.881	.004	7.763	.016	11.644	.036	15.526	.063
28 00	17.449	3.873	.004	7.745	.016	11.618	.036	15.490	.064
15	4.363	3.863	.004	7.727	.016	11.591	.036	15.454	.064
30	8.726	3.854	.004	7.709	.016	11.563	.036	15.418	.064
45	13.088	3.845	.004	7.691	.016	11.536	.036	15.382	.065
29 00	17.451	3.836	.004	7.673	.016	11.509	.036	15.345	.065
15	4.363	3.827	.004	7.654	.016	11.481	.037	15.308	.065
30	8.727	3.817	.004	7.635	.016	11.453	.037	15.270	.066
45	13.091	3.808	.004	7.616	.016	11.425	.037	15.233	.066
30 00	17.454	3.799	.004	7.598	.017	11.396	.037	15.195	.066
15	4.364	3.789	.004	7.578	.017	11.367	.037	15.156	.067
30	8.728	3.779	.004	7.559	.017	11.338	.038	15.118	.067
45	13.092	3.770	.004	7.540	.017	11.309	.038	15.079	.067
31 00	17.457	3.760	.004	7.520	.017	11.280	.038	15.040	.068
15	4.365	3.750	.004	7.500	.017	11.250	.038	15.001	.068
30	8.730	3.740	.004	7.480	.017	11.221	.038	14.961	.068
45	13.095	3.730	.004	7.460	.017	11.191	.038	14.921	.068
32 00	17.460	3.720	.004	7.441	.017	11.161	.039	14.881	.069
15	4.366	3.710	.004	7.420	.017	11.130	.039	14.840	.069
30	8.731	3.700	.004	7.400	.017	11.100	.039	14.799	.069
45	13.097	3.690	.004	7.379	.017	11.069	.039	14.758	.070
33 00	17.462	3.679	.004	7.359	.017	11.038	.039	14.718	.070
15	4.366	3.669	.004	7.338	.018	11.007	.039	14.676	.070
30	8.733	3.658	.004	7.317	.018	10.975	.040	14.633	.070
45	13.099	3.648	.004	7.296	.018	10.943	.040	14.591	.071
34 00	17.465	3.637	.004	7.275	.018	10.912	.040	14.549	.071
15	4.367	3.626	.004	7.253	.018	10.879	.040	14.506	.071
30	8.734	3.616	.004	7.231	.018	10.847	.040	14.463	.071
45	13.101	3.605	.004	7.210	.018	10.815	.040	14.420	.072
35 00	17.468	3.594	.004	7.188	.018	10.782	.040	14.376	.072
15	4.368	3.583	.004	7.166	.018	10.749	.041	14.332	.072
30	8.735	3.572	.004	7.144	.018	10.716	.041	14.288	.072
45	13.103	3.561	.005	7.122	.018	10.683	.041	14.244	.073
36 00	17.471	3.550	.005	7.100	.018	10.650	.041	14.200	.073
15	4.368	3.539	.005	7.077	.018	10.616	.041	14.154	.073
30	8.736	3.527	.005	7.054	.018	10.582	.041	14.109	.073
45	13.105	3.516	.005	7.032	.018	10.547	.041	14.063	.073
37 00	17.473	3.504	.005	7.009	.018	10.513	.041	14.018	.074
15	4.369	3.493	.005	6.986	.018	10.479	.041	13.972	.074
30	8.738	3.481	.005	6.963	.018	10.444	.042	13.925	.074
45	13.108	3.470	.005	6.939	.018	10.409	.042	13.879	.074

TABLE XX.—*Coordinates for projection of maps. Scale* $\frac{1}{250000}$—Continued.

[Prepared by R. S. Woodward.]

Latitude of parallel.		Meridional distances from even degree parallels.	Coordinates of developed parallel for—							
			15′ longitude.		30′ longitude.		45′ longitude.		1° longitude.	
			x	y	x	y	x	y	x	y
°	′	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
38	00	17.477	3.458	.005	6.916	.019	10.374	.042	13.832	.074
	15	4.370	3.446	.005	6.892	.019	10.339	.042	13.785	.074
	30	8.740	3.434	.005	6.869	.019	10.303	.042	13.737	.075
	45	13.110	3.422	.005	6.845	.019	10.267	.042	13.690	.075
39	00	17.480	3.411	.005	6.821	.019	10.232	.042	13.642	.075
	15	4.371	3.398	.005	6.797	.019	10.195	.042	13.594	.075
	30	8.741	3.386	.005	6.773	.019	10.159	.042	13.545	.075
	45	13.112	3.374	.005	6.748	.019	10.123	.042	13.497	.075
40	00	17.483	3.362	.005	6.724	.019	10.086	.042	13.448	.075
	15	4.371	3.350	.005	6.699	.019	10.049	.042	13.399	.075
	30	8.743	3.337	.005	6.675	.019	10.012	.043	13.349	.076
	45	13.114	3.325	.005	6.650	.019	9.975	.043	13.300	.076
41	00	17.486	3.312	.005	6.625	.019	9.937	.043	13.250	.076
	15	4.372	3.300	.005	6.600	.019	9.900	.043	13.200	.076
	30	8.744	3.287	.005	6.575	.019	9.862	.043	13.149	.076
	45	13.117	3.275	.005	6.549	.019	9.824	.043	13.098	.076
42	00	17.489	3.262	.005	6.524	.019	9.786	.043	13.048	.076
	15	4.373	3.249	.005	6.498	.019	9.747	.043	12.996	.076
	30	8.746	3.236	.005	6.472	.019	9.709	.043	12.945	.076
	45	13.119	3.223	.005	6.447	.019	9.670	.043	12.893	.076
43	00	17.492	3.210	.005	6.421	.019	9.631	.043	12.842	.076
	15	4.374	3.197	.005	6.394	.019	9.592	.043	12.789	.076
	30	8.747	3.184	.005	6.368	.019	9.552	.043	12.736	.076
	45	13.121	3.170	.005	6.342	.019	9.513	.043	12.684	.076
44	00	17.495	3.158	.005	6.316	.019	9.473	.043	12.631	.077
	15	4.375	3.144	.005	6.289	.019	9.433	.043	12.578	.077
	30	8.749	3.131	.005	6.262	.019	9.393	.043	12.524	.077
	45	13.124	3.118	.005	6.235	.019	9.353	.043	12.471	.077
45	00	17.498	3.104	.005	6.209	.019	9.313	.043	12.417	.077
	15	4.375	3.091	.005	6.181	.019	9.272	.043	12.363	.077
	30	8.751	3.077	.005	6.154	.019	9.231	.043	12.308	.077
	45	13.126	3.063	.005	6.127	.019	9.190	.043	12.254	.077
46	00	17.501	3.050	.005	6.100	.019	9.150	.043	12.200	.077
	15	4.376	3.036	.005	6.072	.019	9.108	.043	12.144	.077
	30	8.752	3.022	.005	6.044	.019	9.067	.043	12.089	.077
	45	13.128	3.008	.005	6.017	.019	9.025	.043	12.033	.077
47	00	17.504	2.994	.005	5.989	.019	8.983	.043	11.978	.076
	15	4.377	2.980	.005	5.961	.019	8.941	.043	11.922	.076
	30	8.754	2.966	.005	5.933	.019	8.899	.043	11.865	.076
	45	13.131	2.952	.005	5.904	.019	8.857	.043	11.809	.076
48	00	17.508	2.938	.005	5.876	.019	8.814	.043	11.752	.076
	15	4.378	2.924	.005	5.848	.019	8.771	.043	11.695	.076
	30	8.755	2.909	.005	5.819	.019	8.728	.043	11.638	.076
	45	13.133	2.895	.005	5.790	.019	8.686	.043	11.581	.076
49	00	17.511	2.881	.005	5.762	.019	8.643	.043	11.524	.076
	15	4.378	2.866	.005	5.733	.019	8.599	.043	11.465	.076
	30	8.757	2.852	.005	5.704	.019	8.555	.043	11.407	.076
	45	13.135	2.837	.005	5.675	.019	8.512	.042	11.349	.076
50	00	17.514	2.823	.005	5.646	.019	8.468	.042	11.291	.076

TABLE XXI.—*Coordinates for projection of maps. Scale $\frac{1}{125000}$.*

[Prepared by R. S. Woodward.]

Latitude of parallel.		Meridional distances from even degree parallels.	Abscissas of developed parallel.					
			5′ longitude.	10′ longitude.	15′ longitude.	20′ longitude.	25′ longitude.	30′ longitude.
°	′	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
25	00	....	2.650	5.299	7.949	10.599	13.249	15.898
	10	5.815	2.646	5.292	7.938	10.584	13.231	15.877
	20	11.629	2.642	5.285	7.927	10.570	13.212	15.854
	30	17.444	2.639	5.278	7.916	10.555	13.194	15.833
	40	23.259	2.635	5.270	7.905	10.540	13.176	15.811
	50	29.074	2.631	5.263	7.894	10.526	13.157	15.788
26	00	....	2.628	5.256	7.883	10.511	13.139	15.767
	10	5.816	2.624	5.248	7.872	10.496	13.120	15.744
	20	11.631	2.620	5.240	7.861	10.481	13.101	15.721
	30	17.446	2.616	5.233	7.849	10.466	13.082	15.698
	40	23.262	2.613	5.225	7.838	10.451	13.063	15.676
	50	39.077	2.609	5.218	7.827	10.436	13.045	15.654
27	00	....	2.605	5.210	7.816	10.421	13.026	15.631
	10	5.816	2.601	5.203	7.804	10.405	13.006	15.608
	20	11.633	2.597	5.195	7.792	10.390	12.987	15.584
	30	17.449	2.593	5.187	7.780	10.374	12.967	15.560
	40	23.265	2.589	5.179	7.768	10.358	12.947	15.537
	50	29.082	2.586	5.171	7.757	10.342	12.928	15.514
28	00	....	2.582	5.163	7.745	10.327	12.909	15.490
	10	5.817	2.578	5.155	7.733	10.311	12.889	15.466
	20	11.634	2.574	5.147	7.721	10.294	12.868	15.442
	30	17.451	2.570	5.139	7.709	10.278	12.848	15.418
	40	23.268	2.566	5.131	7.697	10.262	12.828	15.394
	50	29.086	2.562	5.123	7.685	10.246	12.808	15.369
29	00	....	2.558	5.115	7.673	10.230	12.788	15.345
	10	5.818	2.553	5.107	7.660	10.213	12.767	15.320
	20	11.636	2.549	5.098	7.648	10.197	12.746	15.295
	30	17.454	2.545	5.090	7.635	10.180	12.725	15.270
	40	23.272	2.541	5.082	7.622	10.163	12.704	15.245
	50	29.090	2.537	5.073	7.610	10.146	12.683	15.220
30	00	....	2.533	5.065	7.598	10.130	12.662	15.195
	10	5.819	2.528	5.056	7.585	10.113	12.641	15.169
	20	11.638	2.524	5.048	7.572	10.096	12.620	15.143
	30	17.457	2.520	5.039	7.559	10.078	12.598	15.118
	40	23.276	2.515	5.031	7.546	10.061	12.577	15.092
	50	29.094	2.511	5.022	7.533	10.044	12.555	15.066
31	00	....	2.507	5.014	7.520	10.027	12.534	15.040
	10	5.820	2.502	5.005	7.507	10.009	12.512	15.014
	20	11.640	2.498	4.996	7.494	9.992	12.490	14.987
	30	17.460	2.493	4.987	7.480	9.974	12.467	14.960
	40	23.280	2.489	4.978	7.467	9.956	12.445	14.934
	50	29.100	2.485	4.969	7.454	9.938	12.423	14.908
32	00	....	2.480	4.960	7.441	9.921	12.401	14.881
	10	5.821	2.476	4.951	7.427	9.903	12.379	14.854
	20	11.642	2.471	4.942	7.413	9.884	12.355	14.827
	30	17.462	2.467	4.933	7.400	9.866	12.333	14.800
	40	23.283	2.462	4.924	7.386	9.848	12.310	14.772
	50	29.104	2.458	4.915	7.373	9.830	12.288	14.745
33	00	....	2.453	4.906	7.359	9.812	12.265	14.717
	10	5.822	2.448	4.896	7.345	9.793	12.241	14.689
	20	11.643	2.444	4.887	7.331	9.774	12.218	14.661
	30	17.465	2.439	4.878	7.316	9.755	12.194	14.633
	40	23.287	2.434	4.868	7.302	9.736	12.171	14.605
	50	29.109	2.429	4.859	7.288	9.718	12.147	14.576
34	00	....	2.425	4.850	7.274	9.699	12.124	14.549
	10	5.823	2.420	4.840	7.260	9.680	12.100	14.520
	20	11.645	2.415	4.830	7.246	9.661	12.076	14.491
	30	17.468	2.410	4.821	7.231	9.642	12.052	14.462
	40	23.291	2.406	4.811	7.217	9.622	12.028	14.434
	50	29.113	2.401	4.802	7.203	9.604	12.004	14.405

Ordinates of developed parallel.		
Longitude interval.	25°	26°
′	*Inch.*	*Inch.*
5	0.001	0.001
10	.003	.003
15	.007	.008
20	.013	.013
25	.020	.021
30	.029	.030
	27°	28°
5	0.001	0.001
10	.003	.004
15	.008	.008
20	.014	.014
25	.022	.022
30	.031	.032
	28°	29°
′	*Inch.*	*Inch.*
5	0.001	0.001
10	.004	.004
15	.008	.008
20	.014	.014
25	.022	.023
30	.032	.032
	30°	31°
5	0.001	0.001
10	.004	.004
15	.008	.008
20	.015	.015
25	.023	.023
30	.033	.034
	31°	32°
′	*Inch.*	*Inch.*
5	0.001	0.001
10	.004	.004
15	.008	.009
20	.015	.015
25	.023	.024
30	.034	.034
	33°	34°
5	0.001	0.001
10	.004	.004
15	.009	.009
20	.016	.016
25	.024	.025
30	.035	.036

TABLE XXI.—*Coordinates of projection of maps. Scale* $\frac{1}{125000}$—Continued.

[Prepared by R. S. Woodward.]

Latitude of parallel.	Meridional distances from even degree parallels.	Abscissas of developed parallel.					
		5′ longitude.	10′ longitude.	15′ longitude.	20′ longitude.	25′ longitude.	30′ longitude.
° ′	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
35 00	....	2.396	4.792	7.188	9.584	11.980	14.376
10	5.824	2.391	4.782	7.174	9.565	11.956	14.347
20	11.647	2.386	4.773	7.159	9.545	11.932	14.318
30	17.471	2.381	4.763	7.144	9.526	11.907	14.288
40	23.294	2.377	4.753	7.130	9.506	11.883	14.259
50	29.118	2.372	4.743	7.115	9.486	11.858	14.230
36 00	....	2.367	4.733	7.099	9.466	11.833	14.200
10	5,824	2.362	4.723	7.085	9.446	11.808	14.170
20	11.649	2.357	4.713	7.070	9.426	11.783	14.139
30	17.473	2.351	4.703	7.055	9.406	11.757	14.109
40	23.297	2.346	4.603	7.039	9.386	11.732	14.078
50	29.122	2.341	4.683	7.024	9.366	11.707	14.048
37 00	....	2.336	4.673	7.009	9.345	11.682	14.018
10	5.826	2.331	4.662	6.994	9.325	11.656	13.987
20	11.651	2.326	4.652	6.978	9.304	11.630	13.956
30	17.477	2.321	4.642	6.963	9.284	11.605	13.925
40	23.302	2.316	4.631	6.947	9.263	11.579	13.894
50	29.128	2.311	4.621	6.932	9.242	11.553	13.864
38 00	....	2.305	4.611	6.916	9.222	11.527	13.832
10	5.827	2.300	4.600	6.900	9.200	11.501	13.801
20	11.653	2.295	4.590	6.884	9.179	11.474	13.769
30	17.480	2.290	4.579	6.869	9.158	11.448	13.737
40	23.306	2.284	4.568	6.853	9.137	11.421	13.705
50	29.133	2.279	4.558	6.837	9.116	11.395	13.673
39 00	....	2.274	4.548	6.821	9.095	11.369	13.642
10	5.828	2.268	4.537	6.805	9.073	11.342	13.610
20	11.655	2.263	4.526	6.789	9.052	11.315	13.577
30	17.483	2.258	4.515	6.773	9.030	11.288	13.545
40	23.310	2.252	4.504	6.756	9.008	11.261	13.513
50	29.138	2.247	4.493	6.740	8.987	11.234	13.480
40 00	....	2.241	4.483	6.724	8.965	11.207	13.448
10	5.829	2.236	4.472	6.707	8.943	11.179	13.415
20	11.657	2.230	4.461	6.691	8.921	11.152	13.382
30	17.486	2.225	4.450	6.674	8.899	11.124	13.349
40	23.314	2.219	4.439	6.658	8.877	11.097	13.316
50	29.143	2.214	4.428	6.641	8.855	11.069	13.283
41 00	....	2.208	4.417	6.625	8.834	11.042	13.250
10	5.830	2.203	4.406	6.608	8.811	11.014	13.217
20	11.659	2.197	4.394	6.591	8.788	10.985	13.183
30	17.489	2.192	4.383	6.575	8.766	10.958	13.149
40	23.319	2.186	4.372	6.558	8.744	10.929	13.115
50	29.149	2.180	4.360	6.541	8.721	10.901	13.081
42 00	....	2.175	4.349	6.524	8.698	10.873	13.048
10	5.831	2.169	4.338	6.507	8.676	10.844	13.013
20	11.661	2.163	4.326	6.490	8.653	10.816	12.979
30	17.492	2.157	4.315	6.472	8.630	10.787	12.945
40	23.323	2.152	4.303	6.455	8.607	10.759	12.910
50	29.154	2.146	4.292	6.438	8.584	10.730	12.876
43 00	....	2.140	4.281	6.421	8.561	10.701	12.842
10	5.832	2.135	4.269	6.403	8.538	10.672	12.807
20	11.663	2.129	4.257	6.386	8.514	10.643	12.772
30	17.495	2.123	4.246	6.368	8.491	10.614	12.737
40	23.327	2.117	4.234	6.351	8.468	10.585	12.701
50	29.159	2.111	4.222	6.333	8.444	10.556	12.667

Ordinates of developed parallel.		
Longitude interval.	34°	35°
′	*Inch.*	*Inch.*
5	0.001	0.001
10	.004	.004
15	.009	.009
20	.016	.016
25	.025	.025
30	.036	.036
	36°	37°
5	0.001	0.001
10	.004	.004
15	.009	.009
20	.016	.016
25	.025	.026
30	.036	.037
	37°	38°
′	*Inch.*	*Inch.*
5	0.001	0.001
10	.004	.004
15	.009	.009
20	.016	.017
25	.026	.026
30	.037	.037
	39°	40°
5	0.001	0.001
10	.004	.004
15	.009	.009
20	.017	.017
25	.026	.026
30	.037	.038
	40°	41°
′	*Inch.*	*Inch.*
5	0.001	0.001
10	.004	.004
15	.009	.009
20	.017	.017
25	.026	.026
30	.038	.038
	42°	43°
5	0.001	0.001
10	.004	.004
15	.010	.010
20	.017	.017
25	.026	.027
30	.038	.038

Table XXI.—*Coordinates for projection of maps. Scale* $\frac{1}{125000}$—Continued.

[Prepared by R. S. Woodward.]

Latitude of parallel.		Meridional distances from even degree parallels.	Abscissas of developed parallel.					
			5′ longitude.	10′ longitude.	15′ longitude.	20′ longitude.	25′ longitude.	30′ longitude.
°	′	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
44	00	....	2.105	4.210	6.316	8.421	10.526	12.631
	10	5.833	2.099	4.199	6.298	8.397	10.496	12.596
	20	11.666	2.093	4.187	6.280	8.373	10.467	12.560
	30	17.498	2.087	4.175	6.262	8.350	10.437	12.524
	40	23.331	2.081	4.163	6.244	8.326	10.407	12.489
	50	29.164	2.076	4.151	6.227	8.302	10.378	12.453
45	00	....	2.070	4.139	6.209	8.278	10.348	12.417
	10	5.834	2.064	4.127	6.191	8.254	10.317	12.381
	20	11.668	2.057	4.115	6.172	8.230	10.288	12.345
	30	17.501	2.051	4.103	6.154	8.206	10.257	12.308
	40	23.335	2.045	4.091	6.136	8.181	10.226	12.272
	50	29.169	2.039	4.079	6.118	8.157	10.197	12.236
46	00	....	2.033	4.067	6.100	8.133	10.166	12.199
	10	5.835	2.027	4.054	6.081	8.108	10.136	12.163
	20	11.670	2.021	4.042	6.063	8.084	10.104	12.125
	30	17.504	2.015	4.030	6.044	8.059	10.074	12.089
	40	23.339	2.009	4.017	6.026	8.034	10.043	12.052
	50	29.174	2.003	4.005	6.008	8.010	10.013	12.015
47	00	....	1.996	3.992	5.989	7.985	9.981	11.978
	10	5.836	1.990	3.980	5.970	7.960	9.951	11.941
	20	11.672	1.984	3.968	5.951	7.935	9.919	11.903
	30	17.508	1.978	3.955	5.933	7.910	9.888	11.866
	40	23.344	1.971	3.943	5.914	7.885	9.857	11.828
	50	29.180	1.965	3.930	5.895	7.860	9.826	11.791
48	00	....	1.959	3.917	5.876	7.835	9.794	11.752
	10	5.837	1.952	3.905	5.857	7.810	9.762	11.714
	20	11.674	1.946	3.892	5.838	7.784	9.730	11.677
	30	17.511	1.940	3.879	5.819	7.759	9.699	11.638
	40	23.348	1.933	3.867	5.800	7.733	9.667	11.600
	50	29.185	1.927	3.854	5.781	7.708	9.635	11.562
49	00	....	1.921	3.841	5.762	7.682	9.603	11.523
	10	5.838	1.914	3.828	5.743	7.657	9.571	11.485
	20	11.676	1.908	3.815	5.723	7.631	9.539	11.446
	30	17.514	1.901	3.803	5.704	7.605	9.507	11.408
	40	23.352	1.895	3.790	5.684	7.579	9.474	11.369
	50	29.190	1.888	3.777	5.665	7.553	9.442	11.330
50	00	....	1.882	3.764	5.646	7.527	9.409	11.291

Ordinates of developed parallel.		
Longitude interval.	43°	44°
′	*Inch.*	*Inch.*
5	0.001	0.001
10	.004	.004
15	.010	.010
20	.017	.017
25	.027	.027
30	.038	.038
	45°	46°
5	0.001	0.001
10	.004	.004
15	.010	.010
20	.017	.017
25	.027	.027
30	.038	.038
	47°	48°
5	0.001	0.001
10	.004	.004
15	.010	.010
20	.017	.017
25	.027	.026
30	.038	.038
	49°	50°
5	0.001	0.001
10	.004	.004
15	.010	.009
20	.017	.017
25	.026	.026
30	.038	.038

TABLE XXII.—*Coordinates for projection of maps. Scale* $\frac{1}{62500}$.

[Prepared by R. S. Woodward.]

Latitude of parallel.		Meridional distances from even degree parallels.	Abscissas of developed parallel.					
			2½' longitude.	5' longitude.	7½' longitude.	10' longitude.	12½' longitude.	15' longitude.
°	'	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
25	00	....	2.650	5.299	7.949	10.599	13.248	15.898
	05	5.815	2.648	5.296	7.944	10.591	13.239	15.887
	10	11.629	2.646	5.292	7.938	10.584	13.230	15.876
	15	17.444	2.644	5.288	7.933	10.577	13.221	15.865
	20	23.259	2.642	5.285	7.927	10.569	13.212	15.854
	25	29.074	2.641	5.281	7.922	10.562	13.203	15.843
	30	34.888	2.639	5.277	7.916	10.555	13.194	15.832
	35	....	2.637	5.274	7.911	10.548	13.184	15.821
	40	....	2.635	5.270	7.905	10.540	13.175	15.810
	45	....	2.633	5.266	7.900	10.533	13.166	15.799
	50	....	2.631	5.263	7.894	10.526	13.157	15.788
	55	....	2.630	5.259	7.889	10.518	13.148	15.777
26	00	....	2.628	5.256	7.883	10.511	13.139	15.766
	05	5.816	2.626	5.252	7.878	10.504	13.129	15.755
	10	11.631	2.624	5.248	7.872	10.496	13.120	15.744
	15	17.447	2.622	5.244	7.866	10.489	13.111	15.733
	20	23.262	2.620	5.241	7.861	10.481	13.101	15.721
	25	29.078	2.618	5.237	7.855	10.473	13.092	15.710
	30	34.893	2.617	5,233	7.849	10.466	13.082	15.699
	35	....	2.615	5.229	7.844	10.458	13.073	15.688
	40	....	2.613	5.225	7.838	10.451	13.064	15.676
	45	....	2.611	5.222	7.833	10.443	13.054	15.665
	50	....	2.609	5.218	7.827	10.436	13.045	15.654
	55	....	2.607	5.214	7.821	10.428	13.035	15.642
27	00	....	2.605	5.210	7.816	10.421	13.026	15.631
	05	5.816	2.603	5.207	7.810	10.413	13.016	15.620
	10	11.633	2.601	5.203	7.804	10.405	13.006	15.608
	15	17.449	2.599	5.199	7.798	10.397	12.997	15.596
	20	23.265	2.597	5.195	7.792	10.389	12.987	15.584
	25	29.082	2.595	5.191	7.786	10.382	12.977	15.572
	30	34.898	2.593	5.187	7.780	10.374	12.967	15.561
	35	....	2.591	5.183	7.774	10.366	12.957	15.549
	40	....	2.590	5.179	7.769	10.358	12.948	15.537
	45	....	2.588	5.175	7.763	10.350	12.938	15.525
	50	....	2.586	5.171	7.757	10.342	12.928	15.514
	55	....	2.584	5.167	7.751	10.335	12.918	15.502
28	00	....	2.582	5.163	7.745	10.327	12.908	15.490
	05	5.817	2.580	5.159	7.739	10.319	12.898	15.478
	10	11.634	2.578	5.155	7.733	10.311	12.888	15.466
	15	17.451	2.576	5.151	7.727	10.303	12.878	15.454
	20	23.268	2.574	5.147	7.721	10.294	12.868	15.442
	25	29.085	2.572	5.143	7.715	10.286	12.858	15.430
	30	34.903	2.570	5.139	7.709	10.278	12.848	15.418
	35	....	2.568	5.135	7.703	10.270	12.838	15.405
	40	....	2.566	5.131	7.697	10.262	12.828	15.393
	45	....	2.564	5.127	7.691	10.254	12.818	15.381
	50	....	2.562	5.123	7.685	10.246	12.808	15.369
	55	....	2.560	5.119	7.679	10.238	12.798	15.357
29	00	....	2.558	5.115	7.673	10.230	12.788	15.345
	05	5.818	2.555	5.111	7.666	10.222	12.777	15.333
	10	11.636	2.553	5.107	7.660	10.213	12.767	15.320
	15	17.454	2.551	5.103	7.654	10.205	12.756	15.308
	20	23.272	2.549	5.098	7.648	10.197	12.746	15.295
	25	29.090	2.547	5.094	7.641	10.188	12.735	15.283
	30	34.908	2.545	5.090	7.635	10.180	12.725	15.270
	35	....	2.543	5.086	7.629	10.172	12.715	15.258
	40	....	2.541	5.082	7.623	10.164	12.704	15.245
	45	....	2.539	5.078	7.616	10.155	12.694	15.233
	50	....	2.537	5.073	7.610	10.147	12.684	15.220
	55	....	2.535	5.069	7.604	10.138	12.673	15.208
30	00	....	2.533	5.065	7.598	10.130	12.663	15.195
	05	5.819	2.530	5.061	7.591	10.122	12.652	15.182
	10	11.638	2.528	5.057	7.585	10.113	12.641	15.169
	15	17.457	2.526	5.052	7.578	10.104	12.630	15.157
	20	23.276	2.524	5.048	7.572	10.096	12.620	15.144
	25	29.095	2.522	5.044	7.565	10.087	12.609	15.131
	30	34.913	2.520	5.039	7.559	10.079	12.598	15.118
	35	....	2.518	5.035	7.552	10.070	12.587	15.105
	40	....	2.515	5.031	7.546	10.061	12.577	15.092
	45	....	2.513	5.026	7.540	10.053	12.566	15.079
	50	....	2.511	5.022	7.533	10.044	12.555	15.066
	55	....	2.509	5.018	7.527	10.036	12.544	15.053

Ordinates of developed parallel.

Longitude interval.	25°	26°
'	*Inch.*	*Inch.*
2½	0.000	0.000
5	.002	.002
7½	.004	.004
10	.007	.007
12½	.010	.010
15	.015	.015

	27°	
'	*Inch.*	
2½	0.000	
5	.002	
7½	.004	
10	.007	
12½	.011	
15	.015	

	27°	28°
'	*Inch.*	*Inch.*
2½	0.000	0.000
5	.002	.002
7½	.004	.004
10	.007	.007
12½	.011	.011
15	.015	.016

	29°	
'	*Inch.*	
2½	0.000	
5	.002	
7½	.004	
10	.007	
12½	.011	
15	.016	

	29°	30°
'	*Inch.*	*Inch.*
2½	0.000	0.000
5	.002	.002
7½	.004	.004
10	.007	.007
12½	.011	.012
15	.016	.017

TABLE XXII.—*Coordinates for projection of maps. Scale* $\frac{1}{62500}$—Continued.

[Prepared by R. S. Woodward.]

Latitude of parallel.		Meridional distances from even degree parallels.	Abscissas of developed parallel.					
			2½′ longitude.	5′ longitude.	7½′ longitude.	10′ longitude.	12½′ longitude.	15′ longitude.
°	′	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
31	00	....	2.507	5.014	7.520	10.027	12.534	15.040
	05	5.820	2.505	5.009	7.514	10.018	12.523	15.027
	10	11.640	2.502	5.005	7.507	10.009	12.512	15.014
	15	17.460	2.500	5.000	7.500	10.000	12.500	15.000
	20	23.280	2.498	4.996	7.494	9.992	12.489	14.987
	25	29.100	2.496	4.991	7.487	9.983	12.478	14.974
	30	34.919	2.494	4.987	7.480	9.974	12.467	14.961
	35	....	2.491	4.983	7.474	9.965	12.456	14.948
	40	....	2.489	4.978	7.467	9.956	12.445	14.934
	45	....	2.487	4.974	7.460	9.947	12.434	14.921
	50	....	2.485	4.969	7.454	9.938	12.423	14.908
	55	....	2.482	4.965	7.447	9.930	12.412	14.894
32	00	....	2.480	4.960	7.441	9.921	12.401	14.881
	05	5.821	2.478	4.956	7.434	9.912	12.390	14.868
	10	11.642	2.476	4.951	7.427	9.903	12.378	14.854
	15	17.462	2.473	4.947	7.420	9.894	12.367	14.840
	20	23.283	2.471	4.942	7.413	9.884	12.356	14.827
	25	29.104	2.469	4.938	7.407	9.875	12.344	14.813
	30	34.925	2.467	4.933	7.400	9.866	12.333	14.800
	35	....	2.464	4.929	7.393	9.857	12.322	14.786
	40	....	2.462	4.924	7.386	9.848	12.310	14.772
	45	....	2.460	4.920	7.379	9.839	12.299	14.759
	50	....	2.458	4.915	7.372	9.831	12.287	14.745
	55	....	2.455	4.910	7.366	9.821	12.276	14.731
33	00	....	2.453	4.906	7.359	9.812	12.265	14.718
	05	5.822	2.451	4.901	7.352	9.802	12.253	14.704
	10	11.643	2.448	4.897	7.345	9.793	12.241	14.690
	15	17.465	2.446	4.892	7.338	9.784	12.230	14.676
	20	23.287	2.444	4.887	7.331	9.774	12.218	14.662
	25	29.109	2.441	4.882	7.324	9.765	12.206	14.648
	30	34.930	2.439	4.878	7.317	9.756	12.195	14.633
	35	....	2.437	4.873	7.310	9.746	12.183	14.619
	40	....	2.434	4.868	7.303	9.737	12.171	14.605
	45	....	2.432	4.864	7.296	9.728	12.160	14.591
	50	....	2.430	4.859	7.289	9.718	12.148	14.577
	55	....	2.427	4.854	7.282	9.709	12.136	14.563
34	00	....	2.425	4.850	7.275	9.700	12.124	14.549
	05	5.823	2.423	4.845	7.267	9.690	12.112	14.535
	10	11.645	2.420	4.840	7.260	9.680	12.100	14.520
	15	17.468	2.418	4.835	7.253	9.671	12.088	14.506
	20	23.291	2.415	4.831	7.246	9.661	12.076	14.492
	25	29.113	2.413	4.826	7.239	9.652	12.064	14.477
	30	34.936	2.411	4.821	7.231	9.642	12.052	14.463
	35	....	2.408	4.816	7.224	9.632	12.040	14.448
	40	....	2.406	4.811	7.217	9.623	12.028	14.434
	45	....	2.403	4.807	7.210	9.613	12.016	14.420
	50	....	2.401	4.802	7.203	9.604	12.004	14.405
	55	....	2.399	4.797	7.195	9.594	11.992	14.391
35	00	....	2.396	4.792	7.188	9.584	11.980	14.376
	05	5.824	2.394	4.787	7.181	9.574	11.968	14.362
	10	11.647	2.391	4.782	7.174	9.565	11.956	14.347
	15	17.471	2.389	4.777	7.166	9.555	11.944	14.332
	20	23.294	2.386	4.773	7.159	9.545	11.931	14.318
	25	29.118	2.384	4.768	7.151	9.535	11.919	14.303
	30	34.942	2.381	4.763	7.144	9.525	11.907	14.288
	35	....	2.379	4.758	7.137	9.516	11.895	14.273
	40	....	2.376	4.753	7.129	9.506	11.882	14.259
	45	....	2.374	4.748	7.122	9.496	11.870	14.244
	50	....	2.372	4.743	7.115	9.486	11.858	14.229
	55	....	2.369	4.738	7.107	9.476	11.845	14.214
36	00	....	2.367	4.733	7.100	9.466	11.833	14.200
	05	5.824	2.364	4.728	7.092	9.456	11.820	14.185
	10	11.649	2.362	4.723	7.085	9.446	11.808	14.169
	15	17.473	2.359	4.718	7.077	9.436	11.795	14.154
	20	23.297	2.357	4.713	7.070	9.426	11.783	14.139
	25	29.122	2.354	4.708	7.062	9.416	11.770	14.124
	30	34.946	2.352	4.703	7.055	9.406	11.758	14.109
	35	....	2.349	4.698	7.047	9.396	11.745	14.094
	40	....	2.346	4.693	7.039	9.386	11.732	14.079
	45	....	2.344	4.688	7.032	9.376	11.720	14.064
	50	....	2.341	4.683	7.024	9.366	11.707	14.048
	55	....	2.339	4.678	7.017	9.356	11.694	14.033

Ordinates of developed parallel.

Longitude interval.	31°	
′	*Inch.*	*Inch.*
2½	0.000	
5	.002	
7½	.004	
10	.008	
12½	.012	
15	.017	

	31°	32°
′	*Inch.*	*Inch.*
2½	0.000	0.000
5	.002	.002
7½	.004	.004
10	.008	.008
12½	.012	.012
15	.017	.017

	33°	
′	*Inch.*	
2½	0.000	
5	.002	
7½	.004	
10	.008	
12½	.012	
15	.017	

	33°	34°
′	*Inch.*	*Inch.*
2½	0.000	0.000
5	.002	.002
7½	.004	.004
10	.008	.008
12½	.012	.012
15	.017	.018

	35°	
′	*Inch.*	
2½	0.000	
5	.002	
7½	.004	
10	.008	
12½	.012	
15	.018	

	35°	36°
′	*Inch.*	*Inch.*
2½	0.000	0.001
5	.002	.002
7½	.004	.005
10	.008	.008
12½	.012	.013
15	.018	.018

TABLE XXII.—*Coordinates for projection of maps. Scale* $\frac{1}{62500}$—Continued.

[Prepared by R. S. Woodward.]

Latitude of parallel.		Meridional distances from even degree parallels.	Abscissas of developed parallel.					
			2½′ longitude.	5′ longitude.	7½′ longitude.	10′ longitude.	12½′ longitude.	15′ longitude.
°	′	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
37	00	....	2.336	4.673	7.009	9.345	11.682	14.018
	05	5.826	2.334	4.667	7.001	9.335	11.669	14.003
	10	11.651	2.331	4.662	6.994	9.325	11.656	13.987
	15	17.477	2.329	4.657	6.986	9.314	11.643	13.972
	20	23.302	2.326	4.652	6.978	9.304	11.630	13.956
	25	29.128	2.323	4.647	6.970	9.294	11.617	13.941
	30	34.954	2.321	4.642	6.963	9.283	11.604	13.925
	35	....	2.318	4.637	6.955	9.273	11.591	13.910
	40	....	2.316	4.631	6.947	9.263	11.578	13.894
	45	....	2.313	4.626	6.939	9.253	11.566	13.879
	50	....	2.311	4.621	6.932	9.242	11.553	13.863
	55	....	2.308	4.616	6.924	9.232	11.540	13.848
38	00	....	2.305	4.611	6.916	9.222	11.527	13.832
	05	5.827	2.203	4.606	6.908	9.211	11.514	13.817
	10	11.653	2.300	4.600	6.900	9.201	11.501	13.801
	15	17.480	2.298	4.595	6.892	9.190	11.488	13.785
	20	23.306	2.295	4.590	6.885	9.179	11.474	13.769
	25	29.133	2.292	4.584	6.877	9.169	11.461	13.753
	30	34.960	2.290	4.579	6.869	9.158	11.448	13.737
	35	....	2.287	4.574	6.861	9.148	11.435	13.722
	40	....	2.284	4.569	6.853	9.137	11.422	13.706
	45	....	2.282	4.563	6.845	9.127	11.408	13.690
	50	....	2.279	4.558	6.837	9.116	11.395	13.674
	55	....	2.276	4.553	6.829	9.106	11.382	13.658
39	00	....	2.274	4.547	6.821	9.095	11.369	13.642
	05	5.828	2.271	4.542	6.813	9.084	11.355	13.626
	10	11.655	2.268	4.537	6.805	9.073	11.342	13.610
	15	17.483	2.266	4.531	6.797	9.063	11.328	13.594
	20	23.310	2.263	4.526	6.789	9.052	11.315	13.578
	25	29.138	2.260	4.521	6.781	9.041	11.301	13.562
	30	34.966	2.258	4.515	6.773	9.030	11.288	13.545
	35	....	2.255	4.510	6.765	9.020	11.274	13.529
	40	....	2.252	4.504	6.757	9.009	11.261	13.513
	45	....	2.250	4.499	6.748	8.998	11.247	13.497
	50	....	2.247	4.494	6.740	8.987	11.234	13.481
	55	....	2.244	4.488	6.732	8.976	11.221	13.465
40	00	....	2.241	4.483	6.724	8.966	11.207	13.448
	05	5.829	2.239	4.477	6.716	8.955	11.193	13.432
	10	11.657	2.236	4.472	6.708	8.944	11.180	13.415
	15	17.486	2.233	4.466	6.699	8.933	11.166	13.399
	20	23.314	2.230	4.461	6.691	8.922	11.152	13.382
	25	29.143	2.228	4.455	6.683	8.911	11.138	13.366
	30	34.972	2.225	4.450	6.675	8.899	11.124	13.349
	35	....	2.222	4.444	6.666	8.888	14.111	13.333
	40	....	2.219	4.439	6.658	8.877	11.097	13.316
	45	....	2.217	4.433	6.650	8.866	11.083	13.300
	50	....	2.214	4.428	6.642	8.855	11.069	13.283
	55	....	2.211	4.422	6.633	8.844	11.056	13.267
41	00	....	2.208	4.417	6.625	8.833	11.042	13.250
	05	5.830	2.206	4.411	6.617	8.822	11.028	13.233
	10	11.659	2.203	4.406	6.608	8.811	11.014	13.216
	15	17.489	2.200	4.400	6.600	8.800	11.000	13.200
	20	23.319	2.197	4.394	6.591	8.789	10.986	13.183
	25	29.149	2.194	4.389	6.583	8.777	10.972	13.166
	30	34.978	2.192	4.383	6.575	8.766	10.958	13.149
	35	....	2.189	4.377	6.566	8.755	10.944	13.132
	40	....	2.186	4.372	6.558	8.744	10.930	13.115
	45	....	2.183	4.366	6.549	8.732	10.916	13.099
	50	....	2.180	4.361	6.541	8.721	10.902	13.082
	55	....	2.178	4.355	6.533	8.710	10.888	13.065
42	00	....	2.175	4.349	6.524	8.699	10.873	13.948
	05	5.831	2.172	4.344	6.515	8.687	10.859	13.031
	10	11.661	2.169	4.338	6.507	8.676	10.845	13.014
	15	17.492	2.166	4.332	6.498	8.664	10.830	12.996
	20	23.323	2.163	4.326	6.490	8.653	10.816	12.979
	25	29.154	2.160	4.321	6.481	8.641	10.802	12.962
	30	34.984	2.158	4.315	6.472	8.630	10.787	12.945
	35	....	2.155	4.309	6.464	8.618	10.773	12.928
	40	....	2.152	4.304	6.455	8.607	10.759	12.910
	45	....	2.149	4.298	6.447	8.596	10.744	12.893
	50	....	2.146	4.292	6.438	8.584	10.730	12.876
	55	....	2.143	4.286	6.429	8.573	10.716	12.859

Ordinates of developed parallel.

Longitude interval.	37°	38°
′	*Inch.*	*Inch.*
2½	0.001	0.001
5	.002	.002
7½	.005	.005
10	.008	.008
12½	.013	.013
15	.018	.019

	39°	
′	*Inch.*	
2½	0.001	
5	.002	
7½	.005	
10	.008	
12½	.013	
15	.019	

	40°	
′	*Inch.*	
2½	0.001	
5	.002	
7½	.005	
10	.008	
12½	.013	
15	.019	

	41°	42°
′	*Inch.*	*Inch.*
2½	0.001	0.001
5	.002	.002
7½	.005	.005
10	.008	.008
12½	.013	.013
15	.019	.019

TABLE XXII.—*Coordinates for projection of maps. Scale* $\frac{1}{62500}$—Continued.

[Prepared by R. S. Woodward.]

Latitude of parallel.	Meridional distances from even degree parallels.	Abscissas of developed parallel.						Ordinates of developed parallel.		
		2½′ longitude.	5′ longitude.	7½′ longitude.	10′ longitude.	12½′ longitude.	15′ longitude.			
° ′	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*			
43 00	....	2.140	4.281	6.421	8.561	10.701	12.842	Longitude interval.	43°	44°
05	5.832	2.137	4.275	6.412	8.550	10.687	12.824			
10	11.663	2.131	4.269	6.403	8.538	10.672	12.807			
15	17.495	2.132	4.263	6.395	8.526	10.658	12.789			
20	23.327	2.129	4.257	6.386	8.514	10.643	12.772			
25	29.159	2.126	4.251	6.377	8.503	10.628	12.754	′	*Inch.*	*Inch.*
30	34.990	2.123	4.246	6.368	8.491	10.614	12.736	2½	0.001	0.001
35	....	2.120	4.240	6.359	8.479	10.599	12.719	5	.002	.002
40	....	2.117	4.234	6.351	8.468	10.585	12.701	7½	.005	.005
45	....	2.114	4.228	6.342	8.456	10.570	12.684	10	.008	.009
50	....	2.111	4.222	6.333	8.444	10.555	12.666	12½	.013	.013
55	....	2.108	4.216	6.324	8.432	10.541	12.649	15	.019	.019
44 00	....	2.105	4.210	6.316	8.421	10.526	12.631			
05	5.833	2.102	4.205	6.307	8.409	10.511	12.613		45°	
10	11.666	2.099	4.199	6.298	8.397	10.496	12.596			
15	17.498	2.096	4.193	6.289	8.385	10.482	12.578			
20	23.331	2.093	4.187	6.280	8.373	10.467	12.560	′	*Inch.*	
25	29.164	2.090	4.181	6.271	8.361	10.452	12.542	2½	0.001	
30	34.997	2.087	4.175	6.262	8.350	10.437	12.524	5	.002	
35	....	2.084	4.169	6.253	8.338	10.422	12.506	7½	.005	
40	....	2.081	4.163	6.244	8.326	10.407	12.489	10	.009	
45	....	2.078	4.157	6.235	8.314	10.392	12.471	12½	.013	
50	....	2.076	4.151	6.227	8.302	10.377	12.453	15	.019	
55	....	2.073	4.145	6.218	8.290	10.363	12.435			
45 00	....	2.070	4.139	6.209	8.278	10.348	12.417			
05	5.834	2.067	4.133	6.200	8.266	10.333	12.399			
10	11.668	2.064	4.127	6.191	8.254	10.318	12.381		45°	46°
15	17.501	2.061	4.121	6.181	8.242	10.302	12.363			
20	23.335	2.058	4.115	6.172	8.230	10.287	12.345	′	*Inch.*	*Inch.*
25	29.169	2.054	4.109	6.163	8.218	10.272	12.327	2½	0.001	0.001
30	35.003	2.051	4.103	6.154	8.206	10.257	12.308	5	.002	.002
35	....	2.048	4.097	6.145	8.194	10.242	12.290	7½	.005	.005
40	....	2.045	4.091	6.136	8.181	10.227	12.272	10	.009	.009
45	....	2.042	4,085	6.127	8.169	10.212	12.254	12½	.013	.013
50	....	2.039	4.079	6.118	8.157	10.197	12.236	15	.019	.019
55	....	2.036	4.073	6.109	8.145	10.182	12.218			
46 00	....	2.033	4.067	6.100	8.133	10.166	12.200		47°	
05	5.835	2.030	4.060	6.091	8.121	10.151	12.181			
10	11.670	2.027	4.054	6.081	8.108	10.136	12.163			
15	17.504	2.024	4.048	6.072	8.096	10.120	12.144	′	*Inch.*	
20	23.339	2.021	4.042	6.063	8.084	10.105	12.126	2½	0.001	
25	29.174	2.018	4.036	6.054	8.072	10.090	12.107	5	.002	
30	35.009	2.015	4.030	6.044	8.059	10.074	12.089	7½	.005	
35	....	2.012	4.023	6.035	8.047	10.059	12.070	10	.008	
40	....	2.009	4.017	6.026	8.035	10.043	12.052	12½	.013	
45	....	2.006	4.011	6.017	8.022	10.028	12.033	15	.019	
50	....	2.003	4.005	6.008	8.010	10.013	12.015			
55	....	1.999	3.999	5.998	7.998	9.997	11.996			
47 00	....	1.996	3.993	5.989	7.985	9.982	11.978		47°	48°
05	5.836	1.993	3.986	5.980	7.973	9.966	11.959			
10	11.672	1.990	3.980	5.970	7.960	9.950	11.940			
15	17.508	1.987	3.974	5.961	7.948	9.935	11.922	′	*Inch.*	*Inch.*
20	23.344	1.984	3.968	5.951	7.935	9.919	11.903	2½	0.001	0.001
25	29.180	1.981	3.961	5.942	7.923	9.903	11.884	5	.002	.002
30	35.015	1.977	3.955	5.933	7.910	9.888	11.865	7½	.005	.005
35	....	1.974	3.949	5.923	7.898	9.872	11.846	10	.008	.008
40	....	1.971	3.943	5.914	7.885	9.856	11.828	12½	.013	.013
45	....	1.968	3.936	5.904	7.872	9.841	11.809	15	.019	.019
50	....	1.965	3.930	5.895	7.860	9.825	11.790			
55	....	1.962	3.924	5.886	7.848	9.809	11.771			
48 00	....	1.959	3.917	5.876	7.835	9.794	11.752		49°	
05	5.837	1.956	3.911	5.867	7.822	9.778	11.733			
10	11.674	1.952	3.905	5.857	7.810	9.763	11.714	′	*Inch.*	
15	17.511	1.949	3.898	5.848	7.797	9.746	11.695	2½	0.001	
20	23.348	1.946	3.892	5.838	7.784	9.730	11.676	5	.002	
25	29.185	1.943	3.886	5.829	7.771	9.714	11.657	7½	.005	
30	35.021	1.940	3.879	5.819	7.759	9.698	11.638	10	.008	
35	....	1.937	3.873	5.810	7.746	9.683	11.619	12½	.013	
40	....	1.933	3.867	5.800	7.733	9.667	11.600	15	.019	
45	....	1.930	3.860	5.790	7.721	9.651	11.581			
50	....	1.927	3.854	5.781	7.708	9.635	11.562			
55	....	1.924	3,848	5.771	7.695	9.619	11.543			

TABLE XXII.—*Coordinates for projection of maps. Scale* $\frac{1}{62500}$—Continued.

[Prepared by R. S. Woodward.]

Latitude of parallel.		Meridional distances from even degree parallels.	Abscissas of developed parallel.					
			2½′ longitude.	5′ longitude.	7½′ longitude.	10′ longitude.	12½′ longitude.	15′ longitude.
°	′	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
49	00	....	1.921	3.841	5.762	7.682	9.603	11.524
	05	5.838	1.917	3.835	5.752	7.670	9.587	11.504
	10	11.676	1.914	3.828	5.742	7.657	9.571	11.485
	15	17.514	1.911	3.822	5.733	7.644	9.555	11.466
	20	23.352	1.908	3.815	5.723	7.631	9.538	11.446
	25	29.190	1.905	3.809	5.713	7.618	9.522	11.427
	30	35.027	1.901	3.802	5.704	7.605	9.506	11.407
	35	....	1.898	3.796	5.694	7.592	9.490	11.388
	40	....	1.895	3.790	5.684	7.579	9.474	11.369
	45	....	1.892	3.783	5.675	7.566	9.458	11.349
	50	....	1.888	3.777	5.665	7.553	9.442	11.330
	55	....	1.885	3.770	5.655	7.540	9.426	11.311
50	00	....	1.882	3.764	5.646	7.528	9.409	11.291

Ordinates of developed parallel.		
Longitude interval.	49°	50°
′	*Inch.*	*Inch.*
2½	0.001	0.001
5	.002	.002
7½	.005	.005
10	.008	.008
12½	.013	.013
15	.019	.019

TABLE XXIII.—*Coordinates for projection of maps. Scale* $\frac{1}{45000}$.

[Prepared by S. S. Gannett.]

Latitude of parallel.		Abscissas of developed parallel.			
		Longitude interval.			
		5′	7½′	10′	15′
°	′	*Inches.*	*Inches.*	*Inches.*	*Inches.*
39	00	6.316	9.474	12.632	18.948
	05	.309	.463	.617	.926
	07½	.305	.457	.609	.914
	10	.301	.451	.602	.903
	15	.294	.440	.587	.881
	20	6.286	9.429	12.572	18.858
	22½	.282	.423	.565	.847
	25	.279	.418	.557	.836
	30	.271	.406	.542	.813
	35	6.264	9.395	12.527	18.791
	37½	.260	.389	.520	.780
	40	.256	.384	.512	.768
	45	.249	.373	.497	.746
	50	6.241	9.361	12.482	18.723
	52½	.237	.356	.475	.712
	55	.234	.350	.467	.701
	60	.226	.339	.452	.678
40	00	6.226	9.339	12.452	18.678
	05	.219	.328	.438	.656
	07½	.215	.322	.429	.644
	10	.211	.316	.422	.633
	15	.203	.305	.406	.609
	20	6.196	9.293	12.392	18.587
	22½	.192	.288	.384	.576
	25	.188	.282	.376	.564
	30	.180	.270	.361	.540
	35	6.173	9.259	12.346	18.518
	37½	.169	.253	.338	.506
	40	.165	.247	.330	.495
	45	.157	.236	.315	.472
	50	6.150	9.224	12.300	18.449
	52½	.146	.219	.292	.438
	55	.142	.213	.285	.427
	60	.134	.201	.269	.403

Ordinates of developed parallel.	
Longitude interval.	Inch.
′	
5	.003
7½	.007
10	.012
15	.026

Latitude interval.	Meridional distances.
′	*Inch.*
1	1.619
2	3.237
3	4.856
4	6.475
5	8.094
6	9.712
7	11.331
8	12.950
9	14.569
10	16.188

Longitude interval.	Inch.
′	
5	.003
7½	.007
10	.012
15	.026

Latitude interval.	Meridional distances.
′	*Inch.*
1	1.619
2	3.238
3	4.857
4	6.476
5	8.095
6	9.714
7	11.333
8	12.952
9	14.571
10	16.190

TABLE XXIII.—*Coordinates for projection of maps. Scale* $\frac{1}{45000}$—Continued.

[Prepared by S. S. Gannett.]

Latitude of parallel.		Abscissas of developed parallel.			
		Longitude interval.			
		5′	7½′	10′	15′
°	′	*Inches.*	*Inches.*	*Inches.*	*Inches.*
41	00	6.134	9.201	12.269	18.403
	05	.127	.190	.254	.380
	07½	.123	.184	.246	.368
	10	.119	.178	.238	.356
	15	.111	.166	.222	.333
	20	6.103	9.155	12.206	18.310
	22½	.099	.149	.198	.298
	25	.095	.143	.190	.286
	30	.087	.131	.175	.263
	35	6.080	9.119	12.159	18.239
	37½	.076	.113	.152	.227
	40	.072	.107	.143	.215
	45	.064	.096	.128	.192
	50	6.056	9.084	12.113	18.169
	52½	.052	.078	.105	.157
	55	.048	.072	.096	.145
	60	.041	.061	.081	.122
42	00	6.041	9.061	12.081	18.122
	05	.033	.049	.066	.098
	07½	.029	.043	.057	.086
	10	.025	.037	.050	.074
	15	.017	.025	.034	.051
	20	6.009	9.013	12.018	18.027
	22½	.005	.007	.010	.015
	25	.001	.001	.002	.003
	30	5.993	8.989	11.986	17.979
	35	5.985	8.978	11.970	17.956
	37½	.981	.971	.963	.944
	40	.977	.966	.955	.932
	45	.969	.954	.939	.908
	50	5.961	8.942	11.923	17.884
	52½	.957	.936	.915	.872
	55	.953	.930	.907	.861
	60	.945	.918	.891	.836
43	00	5.945	8.918	11.891	17.836
	05	.937	.906	.875	.812
	07½	.933	.900	.867	.800
	10	.929	.893	.858	.787
	15	.921	.881	.842	.763
	20	5.913	8.869	11.825	17.738
	22½	.909	.863	.817	.726
	25	.905	.857	.809	.714
	30	.896	.844	.793	.689
	35	5.888	8.832	11.777	17.665
	37½	.884	.826	.769	.653
	40	.880	.820	.760	.640
	45	.872	.808	.744	.616
	50	5.864	8.796	11.728	17.592
	52½	.860	.790	.720	.580
	55	.856	.783	.711	.567
	60	.848	.771	.695	.543

Ordinates of developed parallel.	
Longitude interval.	Inch.
′	
5	.003
7½	.007
10	.012
15	.026

Latitude interval.	Meridional distance.
′	*Inch.*
1	1.619
2	3.239
3	4.858
4	6.477
5	8.097
6	9.716
7	11.335
8	12.955
9	14.574
10	16.193

Longitude interval.	Inch.
′	
5	.003
7½	.007
10	.012
15	.026

Latitude interval.	Meridional distance.
′	*Inch.*
1	1.620
2	3.239
3	4.859
4	6.478
5	8.098
6	9.718
7	11.337
8	12.957
9	14.576
10	16.196

Longitude interval.	Inch.
′	
5	.003
7½	.007
10	.012
15	.026

Latitude interval.	Meridional distance.
′	*Inch.*
1	1.620
2	3.240
3	4.860
4	6.480
5	8.100
6	9.719
7	11.339
8	12.959
9	14.579
10	16.199

TABLE XXIII.—*Coordinates for projection of maps. Scale* $\frac{1}{45000}$—Continued.

[Prepared by S. S. Gannett.]

Latitude of parallel.		Abscissas of developed parallel.			
		Longitude interval.			
		5′	7½′	10′	15′
°	′	*Inches.*	*Inches.*	*Inches.*	*Inches.*
44	00	5.848	8.771	11.695	17.543
	05	.839	.759	.679	.518
	07½	.835	.753	.670	.505
	10	.831	.746	.662	.493
	15	.823	.734	.646	.469
	20	5.815	8.722	11.629	17.444
	22½	.810	.715	.621	.431
	25	.806	.709	.613	.419
	30	.798	.697	.596	.394
	35	5.790	8.685	11.580	17.370
	37½	.786	.678	.571	.357
	40	.782	.672	.563	.345
	45	.773	.660	.547	.320
	50	5.765	8.647	11.530	17.295
	52½	.761	.641	.523	.284
	55	.757	.635	.514	.271
	60	.749	.623	.497	.246

Ordinates of developed parallel.	
Longitude interval.	Inch.
′	
5	.003
7½	.007
10	.012
15	.027

Latitude interval.	Meridional distance.
′	*Inch.*
1	1.620
2	3.240
3	4.861
4	6.481
5	8.101
6	9.721
7	11.341
8	12.962
9	14.582
10	16.202

TABLE XXIV.—*Area of quadrilaterals of Earth's surface of 1° extent in latitude and longitude.*

[Prepared by R. S. Woodward.]

Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.
° ′		° ′		° ′		° ′		° ′		° ′	
0 00	4752.33	15 30	4583.92	30 30	4109.06	45 30	3354.01	60 30	2364.34	75 30	1205.13
0 30	52.16	16 00	72.94	31 00	4088.21	46 00	24.49	61 00	28.02	76 00	1164.49
1 00	51.63	16 30	61.61	31 30	67.05	46 30	3294.71	61 30	2291.51	76 30	23.75
1 30	50.75	17 00	49.94	32 00	45.57	47 00	64.68	62 00	54.82	77 00	1082.01
2 00	49.52	17 30	37.93	32 30	23.79	47 30	34.39	62 30	17.94	77 30	41.99
2 30	47.93										
3 00	46.00	18 00	25.59	33 00	01.69	48 00	03.84	63 00	2180.89	78 00	1000.99
3 30	43.71	18 30	12.90	33 30	3979.30	48 30	3173.04	63 30	43.60	78 30	959.90
4 00	41.07	19 00	4499.87	34 00	56.59	49 00	41.99	64 00	06.26	79 00	18.73
4 30	38.08	19 30	86.51	34 30	33.59	49 30	10.69	64 30	2068.68	79 30	877.49
5 00	34.74	20 00	72.81	35 00	10.28	50 00	3079.15	65 00	30.94	80 00	36.18
5 30	31.04	20 30	58.78	35 30	3886.67	50 30	47.37	65 30	1903.04	80 30	794.79
6 00	27.00	21 00	44.41	36 00	62.76	51 00	15.34	66 00	54.97	81 00	53.34
6 30	22.61	21 30	29.71	36 30	38.56	51 30	2983.08	66 30	16.75	81 30	11.83
7 00	17.86	22 00	14.67	37 00	14.06	52 00	50.58	67 00	1878.37	82 00	670.27
7 30	12.76	22 30	4399.30	37 30	3789.26	52 30	17.85	67 30	39.84	82 30	28.64
8 00	07.32	23 00	83.60	38 00	64.18	53 00	2884.88	68 00	1801.16	83 00	586.97
8 30	01.52	23 30	67.57	38 30	38.80	53 30	51.68	68 30	1762.33	83 30	45.24
9 00	4695.38	24 00	51.21	39 00	13.14	54 00	18.27	69 00	23.36	84 00	03.47
9 30	88.89	24 30	34.52	39 30	3687.18	54 30	2784.62	69 30	1684.24	84 30	461.66
10 00	82.05	25 00	17.51	40 00	60.95	55 00	50.76	70 00	45.00	85 00	19.81
10 30	74.86	25 30	00.17	40 30	34.42	55 30	16.67	70 30	05.62	85 30	377.93
11 00	67.32	26 00	4282.50	41 00	07.62	56 00	2682.37	71 00	1566.10	86 00	36.02
11 30	59.43	26 30	64.51	41 30	3580.54	56 30	47.85	71 30	26.46	86 30	294.08
12 00	51.20	27 00	46.20	42 00	53.17	57 00	13.13	72 00	1486.70	87 00	52.11
12 30	42.63	27 30	27.56	42 30	25.54	57 30	2578.19	72 30	46.81	87 30	10.12
13 00	33.71	28 00	08.61	43 00	3497.62	58 00	43.05	73 00	06.81	88 00	168.12
13 30	24.44	28 30	4189.33	43 30	69.44	58 30	07.70	73 30	1366.69	88 30	126.10
14 00	14.82	29 00	69.74	44 00	40.98	59 00	2472.16	74 00	26.46	89 00	84.07
14 30	04.87	29 30	49.83	44 30	12.26	59 30	36.42	74 30	1286.12	89 30	42.04
15 00	4594.57	30 00	29.60	45 00	3383.27	60 00	00.48	75 00	45.68	90 00	00.00

TABLE XXV.—*Areas of quadrilaterals of Earth's surface of 30′ extent in latitude and longitude.*

[Prepared by R. S. Woodward.]

Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.
° ′		° ′		° ′		° ′		° ′		° ′	
0 30	1188.05	30 30	1027.27	60 30	591.09	0 15	1188.08	30 45	1024.68	60 45	586.56
1 00	1187.92	31 00	1022.06	61 00	582.01	0 45	1188.00	31 15	1019.43	61 15	577.45
1 30	1187.70	31 30	1016.77	61 30	572.88	1 15	1187.82	31 45	1014.10	61 45	568.30
2 00	1187.39	32 00	1011.40	62 00	563.71	1 45	1187.56	32 15	1008.69	62 15	559.11
2 30	1186.99	32 30	1005.96	62 30	554.49	2 15	1187.20	32 45	1003.20	62 45	549.86
						2 45	1186.76				
3 00	1186.51	33 00	1000.43	63 00	545.23	3 15	1186.24	33 15	997.64	63 15	540.58
3 30	1185.95	33 30	994.83	63 30	535.92	3 45	1185.62	33 45	992.00	63 45	531.25
4 00	1185.28	34 00	989.16	64 00	526.57	4 15	1184.92	34 15	986.29	64 15	521.88
4 30	1184.53	34 30	983.41	64 30	517.17	4 45	1184.13	34 45	980.50	64 45	512.46
5 00	1183.70	35 00	977.58	65 00	507.74	5 15	1183.24	35 15	974.64	65 15	503.01
5 30	1182.77	35 30	971.68	65 30	498.26	5 45	1182.28	35 45	968.70	65 45	493.51
6 00	1181.76	36 00	965.70	66 00	488.75	6 15	1181.22	36 15	962.68	66 15	483.97
6 30	1180.66	36 30	959.65	66 30	479.19	6 45	1180.08	36 45	956.60	66 45	474.40
7 00	1179.48	37 00	953.52	67 00	469.60	7 15	1178.85	37 15	950.43	67 15	464.78
7 30	1178.20	37 30	947.32	67 30	459.96	7 45	1177.53	37 45	944.21	67 45	455.13
8 00	1176.84	38 00	941.05	68 00	450.29	8 15	1176.13	38 15	937.88	67 45	455.13
8 30	1175.39	38 30	934.71	68 30	440.59	8 45	1174.63	38 45	931.51	68 15	445.45
9 00	1173.86	39 00	928.29	69 00	430.84	9 15	1173.06	39 15	925.06	68 45	435.72
9 30	1172.23	39 30	921.80	69 30	421.06	9 45	1171.39	39 45	918.53	69 15	425.96
10 00	1170.52	40 00	915.25	70 00	411.25	10 15	1169.63	40 15	911.94	69 45	416.16
10 30	1168.73	40 30	908.61	70 30	401.41	10 45	1167.80	40 45	905.27	70 15	406.34
11 00	1166.84	41 00	901.91	71 00	391.53	11 15	1165.86	41 15	898.54	70 45	396.47
11 30	1164.86	41 30	895.14	71 30	381.62	11 45	1163.85	41 45	891.73	71 15	386.58
12 00	1162.81	42 00	888.30	72 00	371.68	12 15	1161.75	42 15	884.85	71 45	376.65
12 30	1160.67	42 30	881.39	72 30	361.71	12 45	1159.56	42 45	877.91	72 15	366.70
13 00	1158.44	43 00	874.41	73 00	351.71	13 15	1157.29	43 15	870.90	72 45	356.71
13 30	1156.12	43 30	867.37	73 30	341.68	13 45	1154.93	43 45	863.82	73 15	346.69
14 00	1153.72	44 00	860.25	74 00	331.62	14 15	1152.48	44 15	856.67	73 45	336.65
14 30	1151.23	44 30	853.07	74 30	321.53	14 45	1149.95	44 45	849.46	74 15	326.58
15 00	1148.65	45 00	845.82	75 00	311.42	15 15	1147.33	45 15	842.18	74 45	316.48
15 30	1145.99	45 30	838.51	75 30	301.28	15 45	1144.63	45 45	834.83	75 15	306.36
16 00	1143.25	46 00	831.13	76 00	291.12	16 15	1141.84	46 15	827.42	75 45	296.21
16 30	1140.41	46 30	823.68	76 30	280.94	16 45	1138.96	46 45	819.94	76 15	286.04
17 00	1137.50	47 00	816.18	77 00	270.73	17 15	1136.00	47 15	812.40	76 45	275.84
17 30	1134.49	47 30	808.60	77 30	260.50	17 45	1132.96	47 45	804.79	77 15	265.62
18 00	1131.41	48 00	800.97	78 00	250.25	18 15	1129.83	48 15	797.13	77 45	255.38
18 30	1128.24	48 30	793.27	78 30	239.98	18 45	1126.62	48 45	789.39	78 15	245.12
19 00	1124.98	49 00	785.50	79 00	229.68	19 15	1123.32	49 15	781.60	78 45	234.83
19 30	1121.64	49 30	777.68	79 30	219.37	19 45	1119.93	49 45	773.74	79 15	224.53
20 00	1118.21	50 00	769.79	80 00	209.05	20 15	1116.47	50 15	765.83	79 45	214.21
20 30	1114.71	50 30	761.85	80 30	198.70	20 45	1112.92	50 45	757.85	80 15	203.88
21 00	1111.11	51 00	753.84	81 00	188.34	21 15	1109.28	51 15	749.82	80 45	193.52
21 30	1107.44	51 30	745.78	81 30	177.96	21 45	1105.57	51 45	741.72	81 15	183.15
22 00	1103.68	52 00	737.65	82 00	167.57	22 15	1101.77	52 15	733.57	81 45	172.77
22 30	1099.84	52 30	729.47	82 30	157.16	22 45	1097.88	52 45	725.36	82 15	162.37
23 00	1095.91	53 00	721.23	83 00	146.74	23 15	1093.92	53 15	717.08	82 45	151.95
23 30	1091.90	53 30	712.93	83 30	136.31	23 45	1089.87	53 45	708.76	83 15	141.53
24 00	1087.81	54 00	704.57	84 00	125.87	24 15	1085.74	54 15	700.38	83 45	131.09
24 30	1083.64	54 30	696.16	84 30	115.42	24 45	1081.52	54 45	691.94	84 15	120.64
25 00	1079.39	55 00	687.70	85 00	104.95	25 15	1077.23	55 15	683.44	84 45	110.18
25 30	1075.05	55 30	679.17	85 30	94.48	25 45	1072.85	55 45	674.89	85 15	99.72
26 00	1070.64	56 00	670.60	86 00	84.01	26 15	1068.40	56 15	666.29	85 45	89.25
26 30	1066.14	56 30	661.97	86 30	73.52	26 45	1063.86	56 45	657.64	86 15	78.76
27 00	1061.56	57 00	653.29	87 00	63.03	27 15	1059.24	57 15	648.93	86 45	68.27
27 30	1056.90	57 30	644.55	87 30	52.53	27 45	1054.54	57 45	640.17	87 15	57.78
28 00	1052.16	58 00	635.77	88 00	42.03	28 15	1049.76	58 15	631.36	87 45	47.28
28 30	1047.34	58 30	626.93	88 30	31.53	28 45	1044.90	58 45	622.49	88 15	36.78
29 00	1042.44	59 00	618.05	89 00	21.02	29 15	1039.97	59 15	613.59	88 45	26.27
29 30	1037.47	59 30	609.11	89 30	10.51	29 45	1034.95	59 45	604.62	89 15	15.76
30 00	1032.41	60 00	600.13	90 00	00.00	30 15	1029.85	60 15	595.62	89 45	5.26

TABLE XXVI.—*Areas of quadrilaterals of Earth's surface of 15′ extent in latitude and longitude.*

[Prepared by R. S. Woodward.]

Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.
° ′ ″		° ′ ″		° ′ ″		° ′ ″		° ′ ″		° ′ ″	
0 07 30	297.02	8 15 00	294.03	16 22 30	285.28	24 30 00	270.91	32 37 30	251.15	40 45 00	226.32
0 15 00	297.02	8 22 30	293.94	16 30 00	285.10	24 37 30	270.65	32 45 00	250.80	40 52 30	225.90
0 22 30	297.02	8 30 00	293.85	16 37 30	284.92	24 45 00	270.38	32 52 30	250.45	41 00 00	225.48
0 30 00	297.01	8 37 30	293.75	16 45 00	284.74	24 53 30	270.11	33 00 00	250.11	41 07 30	225.06
0 37 30	297.01	8 45 00	293.66	16 52 30	284.56	25 00 00	269.85	33 07 30	249.76	41 15 00	224.64
0 45 00	297.00	8 52 30	293.56	17 00 00	284.38	25 07 30	269.58	33 15 00	249.41	41 22 30	224.21
0 52 30	296.99	9 00 00	293.47	17 07 30	284.19	25 15 00	269.31	33 22 30	249.06	41 30 00	223.79
1 00 00	296.98	9 07 30	293.37	17 15 00	284.00	25 22 30	269.04	33 30 00	248.71	41 37 30	223.36
1 07 30	296.97	9 15 00	293.27	17 22 30	283.81	25 30 00	268.76	33 37 30	248.36	41 45 00	222.93
1 15 00	296.96	9 22 30	293.16	17 30 00	283.62	25 37 30	268.49	33 45 00	248.00	41 52 30	222.50
1 22 30	296.94	9 30 00	293.06	17 37 30	283.43	25 45 00	268.21	33 52 30	247.65	42 00 00	222.08
1 30 00	296.93	9 37 30	292.95	17 45 00	283.24	25 52 30	267.94	34 00 00	247.29	42 07 30	221.65
1 37 30	296.91	9 45 00	292.85	17 52 30	283.05	26 00 00	267.66	34 07 30	246.93	42 15 00	221.21
1 45 00	296.89	9 52 30	292.74	18 00 00	282.86	26 07 30	267.38	34 15 00	246.57	42 22 30	220.78
1 52 30	296.87	10 00 00	292.63	18 07 30	282.66	26 15 00	267.10	34 22 30	246.21	42 30 00	220.35
2 00 00	296.85	10 07 30	292.52	18 15 00	282.46	26 22 30	266.82	34 30 00	245.85	42 37 30	219.91
2 07 30	296.82	10 15 00	292.41	18 22 30	282.26	26 30 00	266.54	34 37 30	245.49	42 45 00	219.48
2 15 00	296.80	10 22 30	292.30	18 30 00	282.06	26 37 30	266.25	34 45 00	245.13	42 52 30	219.04
2 22 30	296.77	10 30 00	292.19	18 37 30	281.86	26 45 00	265.97	34 52 30	244.76	43 00 00	218.60
2 30 00	296.75	10 37 30	292.07	18 45 00	281.66	26 52 30	265.68	35 00 00	244.40	43 07 30	218.16
2 37 30	296.72	10 45 00	291.95	18 52 30	281.45	27 00 00	265.39	35 07 30	244.03	43 15 00	217.73
2 45 00	296.69	10 52 30	291.83	19 00 00	281.25	27 07 30	265.10	35 15 00	243.66	43 22 30	217.28
2 52 30	296.66	11 00 00	291.71	19 07 30	281.04	27 15 00	264.81	35 22 30	243.29	43 30 00	216.84
3 00 00	296.63	11 07 30	291.59	19 15 00	280.83	27 22 30	264.52	35 30 00	242.92	43 37 30	216.40
3 07 30	296.60	11 15 00	291.47	19 22 30	280.62	27 30 00	264.23	35 37 30	242.55	43 45 00	215.96
3 15 00	296.56	11 22 30	291.34	19 30 00	280.41	27 37 30	263.93	35 45 00	242.18	43 52 30	215.51
3 22 30	296.53	11 30 00	291.22	19 37 30	280.20	27 45 00	263.64	35 52 30	241.80	44 00 00	215.06
3 30 00	296.49	11 37 30	291.09	19 45 00	279.99	27 52 30	263.34	36 00 00	241.43	44 07 30	214.61
3 37 30	296.45	11 45 00	290.96	19 52 30	279.77	28 00 00	263.04	36 07 30	241.05	44 15 00	214.17
3 45 00	296.41	11 52 30	290.83	20 00 00	279.55	28 07 30	262.74	36 15 00	240.67	44 22 30	213.72
3 52 30	296.36	12 00 00	290.70	20 07 30	279.34	28 15 00	262.44	36 22 30	240.29	44 30 00	213.27
4 00 00	296.32	12 07 30	290.57	20 15 00	279.12	28 22 30	262.14	36 30 00	239.91	44 37 30	212.82
4 07 30	296.28	12 15 00	290.44	20 22 30	278.90	28 30 00	261.84	36 37 30	239.53	44 45 00	212.37
4 15 00	296.23	12 22 30	290.30	20 30 00	278.68	28 37 30	261.53	36 45 00	239.15	44 52 30	211.91
4 22 30	296.18	12 30 00	290.17	20 37 30	278.46	28 45 00	261.23	36 52 30	238.77	45 00 00	211.46
4 30 00	296.13	12 37 30	290.03	20 45 00	278.23	28 52 30	260.92	37 00 00	238.38	45 07 30	211.00
4 37 30	296.08	12 45 00	289.89	20 52 30	278.00	29 00 00	260.61	37 07 30	237.99	45 15 00	210.55
4 45 00	296.03	12 52 30	289.75	21 00 00	277.78	29 07 30	260.30	37 15 00	237.61	45 22 30	210.09
4 52 30	295.98	13 00 00	289.61	21 07 30	277.55	29 15 00	259.99	37 22 30	237.22	45 30 00	209.63
5 00 00	295.93	13 07 30	289.47	21 15 00	277.32	29 22 30	259.68	37 30 00	236.83	45 37 30	209.17
5 07 30	295.87	13 15 00	289.33	21 22 30	277.09	29 30 00	259.37	37 37 30	236.44	45 45 00	208.71
5 15 00	295.81	13 22 30	289.18	21 30 00	276.86	29 37 30	259.05	37 45 00	236.05	45 52 30	208.25
5 22 30	295.75	13 30 00	289.03	21 37 30	276.63	29 45 00	258.74	37 52 30	235.66	46 00 00	207.78
5 30 00	295.69	13 37 30	288.88	21 45 00	276.39	29 52 30	258.42	38 00 00	235.26	46 07 30	207.32
5 37 30	295.63	13 45 00	288.73	21 52 30	276.16	30 00 00	258.10	38 07 30	234.87	46 15 00	206.86
5 45 00	295.57	13 52 30	288.58	22 00 00	275.92	30 07 30	257.78	38 15 00	234.47	46 22 30	206.39
5 52 30	295.51	14 00 00	288.43	22 07 30	275.68	30 15 00	257.46	38 22 30	234.07	46 30 00	205.92
6 00 00	295.44	14 07 30	288.28	22 15 00	275.44	30 22 30	257.14	38 30 00	233.68	46 37 30	205.45
6 07 30	295.37	14 15 00	288.12	22 22 30	275.20	30 30 00	256.82	38 37 30	233.28	46 45 00	204.99
6 15 00	295.31	14 22 30	287.96	22 30 00	274.96	30 37 30	256.49	38 45 00	232.88	46 52 30	204.52
6 22 30	295.24	14 32 00	287.81	22 37 30	274.72	30 45 00	256.17	38 52 30	232.48	47 00 00	204.05
6 30 00	295.17	14 37 30	287.65	22 45 00	247.47	30 52 30	255.84	39 00 00	232.07	47 07 30	203.57
6 37 30	295.09	14 45 00	287.49	22 52 30	274.22	31 00 00	255.52	39 07 30	231.67	47 15 00	203.10
6 45 00	295.02	14 52 30	287.33	23 00 00	273.98	31 07 30	255.19	39 15 00	231.27	47 22 30	202.63
6 52 30	294.95	15 00 00	287.17	23 07 30	273.73	31 15 00	254.86	39 22 30	230.86	47 30 00	202.15
7 00 00	294.87	15 07 30	287.00	23 15 00	273.48	31 22 30	254.53	39 30 00	230.45	47 37 30	201.67
7 07 30	294.79	15 15 00	286.83	23 22 30	273.23	31 30 00	254.19	39 37 30	230.04	47 45 00	201.20
7 15 00	294.71	15 22 30	286.67	23 30 00	272.98	31 37 30	253.86	39 45 00	229.63	47 52 30	200.72
7 22 30	294.63	15 30 00	286.50	23 37 30	272.72	31 45 00	253.53	39 52 30	229.22	48 00 00	200.24
7 30 00	294.55	15 37 30	286.33	23 45 00	272.47	31 52 30	253.19	40 00 00	228.81	48 07 30	199.76
7 37 30	294.47	15 45 00	286.16	23 52 30	272.21	32 00 00	252.85	40 07 30	228.40	48 15 00	199.28
7 45 00	294.39	15 52 30	285.99	24 00 00	271.95	32 07 30	252.51	40 15 00	227.99	48 22 30	198.80
7 52 30	294.30	16 00 00	285.82	24 07 30	271.69	32 15 00	252.17	40 22 30	227.57	48 30 00	198.32
8 00 00	294.21	16 07 30	285.64	24 15 00	271.44	32 22 30	251.83	40 30 00	227.15	48 37 30	197.83
8 07 30	294.12	16 15 00	285.46	24 22 30	271.17	32 30 00	251.49	40 37 30	226.73	48 45 00	197.35

TABLE XXVI.—*Areas of quadrilaterals of Earth's surface of 15′ extent in latitude and longitude*—Cont'd.

[Prepared by R. S. Woodward.]

Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.	Middle latitude of quadrilateral.	Area in square miles.
° ′ ″		° ′ ″		° ′ ″		° ′ ″		° ′ ″		° ′ ″	
48 52 30	196.86	55 45 00	168.72	62 37 30	138.04	69 30 00	105.27	76 22 30	70.87	83 15 00	35.38
49 00 00	196.38	55 52 30	168.19	62 45 00	137.47	69 37 30	104.65	76 30 00	70.24	83 22 30	34.73
49 07 30	195.89	56 00 00	167.65	62 52 30	136.89	69 45 00	104.04	76 37 30	69.60	83 30 00	34.08
49 15 00	195.40	56 07 30	167.11	63 00 00	136.31	69 52 30	103.43	76 45 00	68.96	83 37 30	33.42
49 22 30	194.91	56 15 00	166.57	63 07 30	135.73	70 00 00	102.81	76 52 30	68.32	83 45 00	32.77
49 30 00	194.42	56 22 30	166.03	63 15 00	135.15	70 07 30	102.20	77 00 00	67.68	83 52 30	32.12
49 37 30	193.93	56 30 00	165.49	63 22 30	134.56	70 15 00	101.59	77 07 30	67.04	84 00 00	31.47
49 45 00	193.44	56 37 30	164.95	63 30 00	133.98	70 22 30	100.97	77 15 00	66.41	84 07 30	30.81
49 52 30	192.94	56 45 00	164.41	63 37 30	133.40	70 30 00	100.35	77 22 30	65.77	84 15 00	30.16
50 00 00	192.45	56 52 30	163.87	63 45 00	132.81	70 37 30	99.74	77 30 00	65.13	84 22 30	29.51
50 07 30	191.95	57 00 00	163.32	63 52 30	132.23	70 45 00	99.12	77 37 30	64.49	84 30 00	28.86
50 15 00	191.46	57 07 30	162.78	64 00 00	131.64	70 52 30	98.50	77 45 00	63.85	84 37 30	28.20
50 22 30	190.96	57 15 00	162.23	64 07 30	131.06	71 00 00	97.88	77 52 30	63.20	84 45 00	27.54
50 30 00	190.46	57 22 30	161.68	64 15 00	130.47	71 07 30	97.26	78 00 00	62.56	84 52 30	26.89
50 37 30	189.96	57 30 00	161.14	64 22 30	129.88	71 15 00	96.65	78 07 30	61.92	85 00 00	26.24
50 45 00	189.46	57 37 30	160.59	64 30 00	129.29	71 22 30	96.03	78 15 00	61.28	85 07 30	25.58
50 52 30	188.96	57 45 00	160.04	64 37 30	128.70	71 30 00	95.41	78 22 30	60.64	85 15 00	24.93
51 00 00	188.46	57 52 30	159.49	64 45 00	128.12	71 37 30	94.78	78 30 00	60.00	85 22 30	24.27
51 07 30	187.96	58 00 00	158.94	64 52 30	127.53	71 45 00	94.16	78 37 30	59.35	85 30 00	23.62
51 15 00	187.46	58 07 30	158.39	65 00 00	126.94	71 52 30	93.54	78 45 00	58.71	85 37 30	22.97
51 22 30	186.95	58 15 00	157.84	65 07 30	126.34	72 00 00	92.92	78 52 30	58.06	85 45 00	22.31
51 30 00	186.45	58 22 30	157.29	65 15 00	125.75	72 07 30	92.30	79 00 00	57.42	85 52 30	21.66
51 37 30	185.94	58 30 00	156.73	65 22 30	125.16	72 15 00	91.68	79 07 30	56.78	86 00 00	21.00
51 45 00	185.43	58 37 30	156.18	65 30 00	124.57	72 22 30	91.05	79 15 00	56.13	86 07 30	20.35
51 52 30	184.92	58 45 00	155.62	65 37 30	123.97	72 30 00	90.43	79 22 20	55.49	86 15 00	19.69
52 00 00	184.41	58 52 30	155.07	65 45 00	123.38	72 37 30	89.80	79 30 00	54.84	86 22 30	19.04
52 07 30	183.90	59 00 00	154.51	65 52 30	122,78	72 45 00	89.18	79 37 30	54.20	86 30 00	18.38
52 15 00	183.39	59 07 30	153.96	66 00 00	122.19	72 52 30	88.55	79 45 00	53.55	86 37 30	17.72
52 22 30	182.88	59 15 00	153.41	66 07 30	121.59	73 00 00	87.93	79 52 30	52.91	86 45 00	17.07
52 30 00	182.37	59 22 30	152.84	66 15 00	120.99	73 07 30	87.30	80 00 00	52.26	86 52 30	16.41
52 37 30	181.85	59 30 00	152.28	66 22 30	120.40	73 15 00	86.67	80 07 30	51.62	87 00 00	15.76
52 45 00	181.34	59 37 30	151.72	66 30 00	119.80	73 22 30	86.05	80 15 00	50.97	87 07 30	15.10
52 52 30	180.82	59 45 00	151.16	66 37 30	119.20	73 30 00	85.42	80 22 30	50.32	87 15 00	14.44
53 00 00	180.31	59 52 30	150.60	66 45 00	118.60	73 37 30	84.79	80 30 00	49.68	87 22 30	13.79
53 07 30	179.79	60 00 00	150.03	66 52 30	118.00	73 45 00	84.16	80 37 30	49.03	87 30 00	13.13
53 15 00	179.27	60 07 30	149.47	67 00 00	117.40	73 52 30	83.53	80 45 00	48.38	87 37 30	12.48
53 22 30	178.75	60 15 00	148.91	67 07 30	116.80	74 00 00	82.91	80 52 30	47.73	87 45 00	11.82
53 30 00	178.23	60 22 30	148.34	67 15 00	116.20	74 07 30	82.28	81 00 00	47.08	87 52 30	11.16
53 37 30	177.71	60 30 00	147.77	67 22 30	115.59	74 15 00	81.65	81 07 30	46.44	88 00 00	10.51
53 45 00	177.19	60 37 30	147.21	67 30 00	114.99	74 22 30	81.01	81 15 00	45.79	88 07 30	9.85
53 52 30	176.67	60 45 00	146.64	67 37 30	114.39	74 30 00	80.38	81 22 30	45.14	88 15 00	9.20
54 00 00	176.14	60 52 30	146.07	67 45 00	113.78	74 37 30	79.75	81 30 00	44.49	88 22 30	8.54
54 07 30	175.62	61 00 00	145.50	67 52 30	113.18	74 45 00	79.12	81 37 30	43.84	88 30 00	7.88
54 15 00	175.10	61 07 30	144.93	68 00 00	112.57	74 52 30	78.49	81 45 00	43.19	88 37 30	7.22
54 22 30	174.57	61 15 00	144.36	68 07 30	111.97	75 00 00	77.86	81 52 30	42.54	88 45 00	6.57
54 30 00	174.04	61 22 30	143.79	68 15 00	111.36	75 07 30	77.22	82 00 00	41.89	88 52 30	5.91
54 37 30	173.51	61 30 00	143.22	68 22 30	110.76	75 15 00	76.59	82 07 30	41.24	89 00 00	5.26
54 45 00	172.99	61 37 30	142.65	68 30 00	110.15	75 22 30	75.95	82 15 00	40.59	89 07 30	4.60
54 52 30	172.46	61 47 00	142.08	68 37 30	109.54	75 30 00	75.32	82 22 30	39.94	89 15 00	3.94
55 00 00	171.93	61 52 30	141.50	68 45 00	108.93	75 37 30	74.69	82 30 00	39.29	89 22 30	3.28
55 07 30	171.39	62 00 00	140.93	68 52 30	108.32	75 45 00	74.05	82 37 30	38.64	89 30 00	2.63
55 15 00	170.86	62 07 30	140.35	69 00 00	107.71	75 52 30	73.42	82 45 00	37.99	89 37 30	1.97
55 22 30	170.33	62 15 00	139.78	69 07 30	107.10	76 00 00	72.78	82 52 30	37.34	89 45 00	1.31
55 30 00	169.79	62 22 30	139.20	69 15 00	106.49	76 07 30	72.14	83 00 00	36.69	89 52 30	0.66
55 37 30	169.26	62 30 00	138.62	69 22 30	105.88	76 15 00	71.51	83 07 30	36.03		

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths.*

[From Appendix No. 7, Report U. S. Coast and Geodetic Survey, 1884.]

LATITUDE 25°.

Latitude.		log. A	log. B	log. C	log. D	log. E
		diff. 1″ = −0.06	diff. 1″ = −0.16	diff. 1″ = +0.54	diff. 1″ = +0.03	diff. 1″ = +0.04
°	′					
25	00	8.509 4639	8.511 8881	1.07457	2.2762	5.8300
	1	36	71	490	64	03
	2	32	62	523	66	05
	3	29	52	555	68	08
	4	26	42	588	70	11
	05	23	32	621	72	13
	6	19	22	654	75	16
	7	16	12	687	77	18
	8	13	02	719	79	21
	9	09	8.511 8793	752	81	24
	10	8.509 4606	8.511 8783	1.07785	2.2783	5.8326
	11	03	73	817	85	29
	12	00	63	850	87	32
	13	8.509 4596	53	883	89	34
	14	93	43	915	91	37
	15	90	33	948	93	39
	16	86	23	981	96	42
	17	83	13	1.08013	98	45
	18	80	04	046	2.2800	47
	19	76	8.511 8694	078	02	50
	20	8.509 4573	8.511 8684	1.08111	2.2804	5.8352
	21	70	74	143	06	55
	22	66	64	176	08	59
	23	63	54	208	10	60
	24	60	44	241	12	63
	25	56	34	273	14	66
	26	53	24	306	16	68
	27	50	14	338	18	71
	28	46	04	370	20	73
	29	43	8.511 8594	403	23	76
	30	8.509 4540	8.511 8584	1.08435	2.2825	5.8379
	31	37	74	468	27	81
	32	33	64	500	29	84
	33	30	54	582	31	87
	34	26	44	565	33	89
	35	23	34	597	35	92
	36	20	24	629	37	94
	37	17	14	662	39	97
	38	13	04	694	41	5.8400
	39	10	8.511 8494	726	43	02
	40	8.509 4507	8.511 8484	1.08758	2.2845	5.8405
	41	03	74	791	47	08
	42	00	64	823	49	10
	43	8.509 4496	54	855	51	13
	44	93	44	887	53	16
	45	90	34	919	55	18
	46	86	24	951	57	21
	47	83	14	984	59	24
	48	80	04	1.09016	61	26
	49	76	8.511 8393	048	63	29
	50	8.509 4473	8.511 8383	1.09080	2.2865	5.8431
	51	70	73	112	67	34
	52	66	63	144	69	37
	53	63	53	176	71	39
	54	60	43	208	73	42
	55	56	33	240	75	45
	56	53	23	272	77	47
	57	50	13	304	79	50
	58	46	03	336	81	53
	59	43	8.511 8293	368	83	55
	60	8.509 4439	8.511 8283	1.09400	2.2885	5.8458

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 26°.

Latitude.	log. A	log. B	log. C	log. D	log. E
	diff. 1″ = −0.06	diff. 1″ = −0.17	diff. 1″ = +0.52	diff. 1″ = +0.03	diff. 1″ = +0.04
° ′					
26 00	8.509 4439	8.511 8283	1.09400	2.2885	5.8458
1	36	72	432	87	61
2	33	62	464	89	63
3	29	52	496	91	66
4	26	42	527	93	69
05	22	32	559	95	71
6	19	22	591	97	74
7	16	12	623	99	77
8	12	01	655	2.2901	79
9	09	8.511 8191	687	03	82
10	8.509 4406	8.511 8181	1.09718	2.2905	5.8485
11	02	71	750	07	88
12	8.509 4399	61	782	09	90
13	95	51	814	11	93
14	92	40	845	13	96
15	88	30	877	15	98
16	85	20	909	17	5.8501
17	82	10	940	19	04
18	78	00	972	20	06
19	75	8.511 8089	1.10004	22	09
20	8.509 4372	8.511 8079	1.10036	2.2924	5.8512
21	68	69	067	26	14
22	65	59	099	28	17
23	61	48	130	30	20
24	58	38	162	32	22
25	54	28	194	34	25
26	51	18	225	36	28
27	48	08	257	38	30
28	44	8.511 7997	288	40	33
29	41	87	320	42	36
30	8.509 4337	8.511 7977	1.10351	2.2944	5.8539
31	34	67	383	46	41
32	31	56	414	47	44
33	27	46	446	49	47
34	24	36	477	51	49
35	20	25	509	53	52
36	17	15	540	55	55
37	13	05	571	57	57
38	10	8.511 7895	603	59	60
39	07	84	634	61	63
40	8.509 4303	8.511 7874	1.10666	2.2963	5.8566
41	00	64	697	65	68
42	8.509 4296	53	728	66	71
43	93	43	760	68	74
44	89	33	791	70	76
45	86	22	822	72	79
46	83	12	854	74	82
47	79	02	885	76	85
48	76	8.511 7791	916	78	87
49	72	81	947	80	90
50	8.509 4269	8.511 7771	1.10979	2.2981	5.8593
51	65	60	1.11010	83	95
52	62	50	041	85	98
53	58	40	072	87	5.8601
54	55	29	103	89	04
55	52	19	134	91	06
56	48	09	166	93	09
57	45	8.511 7698	197	94	12
58	41	88	228	96	14
59	38	77	259	98	17
60	8.509 4234	8.511 7667	1.11290	2.3000	5.8620

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 27°.

Latitude.	log. A	log. B	log. C	log. D	log. E
	diff. 1″=−0.06	diff. 1″=−0.18	diff. 1″=+0.51	diff. 1″=+0.03	diff. 1″=+0.05
° ′					
27 00	8.509 4234	8.511 7667	1.11290	2.3000	5.8620
1	31	57	321	02	23
2	27	46	352	04	25
3	24	36	383	06	28
4	20	25	414	07	31
5	17	15	445	09	34
6	13	05	476	11	36
7	10	8.511 7594	507	13	39
8	06	84	538	15	42
9	03	73	569	17	44
10	8.509 4200	8.511 7563	1.11600	2.3018	5.8647
11	8.509 4196	53	631	20	50
12	93	42	662	22	53
13	89	32	693	24	55
14	86	21	724	26	58
15	82	11	755	27	61
16	79	00	786	29	64
17	75	8.511 7490	817	31	66
18	72	79	848	33	69
19	68	69	878	35	72
20	8.509 4165	8.511 7458	1.11909	2.3037	5.8675
21	61	48	940	38	77
22	58	37	971	40	80
23	54	27	1.12002	42	83
24	51	16	032	44	86
25	47	06	063	45	88
26	44	8.511 7395	094	47	91
27	40	85	125	49	94
28	37	74	156	51	97
29	33	64	186	53	99
30	8.509 4130	8.511 7353	1.12217	2.3054	5.8702
31	26	43	248	56	05
32	23	32	278	58	08
33	19	22	309	60	10
34	16	11	340	61	13
35	12	01	370	63	16
36	08	8.511 7290	401	65	19
37	05	80	432	67	22
38	01	69	462	69	24
39	8.509 4098	58	493	70	27
40	8.509 4094	8.511 7248	1.12523	2.3072	5.8730
41	91	37	554	74	33
42	87	27	584	76	35
43	84	16	615	77	38
44	80	06	646	79	41
45	77	8.511 7195	676	81	44
46	73	84	707	83	46
47	70	74	737	84	49
48	66	63	768	86	52
49	63	53	798	88	55
50	8.509 4059	8.511 7142	1.12829	2.3090	5.8757
51	56	31	859	91	60
52	52	21	889	93	63
53	49	10	920	95	66
54	45	00	950	96	69
55	41	8.511 7089	981	98	72
56	38	78	1.13011	2.3100	74
57	34	68	041	02	77
58	31	57	072	03	80
59	27	46	102	05	83
60	8.509 4024	8.511 7036	1.13132	2.3107	5.8785

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 28°.

Latitude.	log. A diff. 1″=—0.06	log. B diff. 1″=—0.18	log. C diff. 1″=+0.50	log. D diff. 1″=+0.03	log. E diff. 1″=+0.05
° ′					
28 00	8.509 4024	8.511 7036	1.13132	2.3107	5.8785
1	20	25	163	09	88
2	17	14	193	10	91
3	13	04	223	12	94
4	10	8.511 6993	254	14	97
05	06	82	284	15	99
6	02	72	314	17	5.8802
7	8.509 3999	61	345	19	05
8	95	50	375	20	08
9	92	40	405	22	11
10	8.509 3988	8.511 6929	1.13435	2.3124	5.8813
11	85	18	465	26	16
12	81	08	496	27	19
13	78	8.511 6897	526	29	22
14	74	86	556	31	25
15	70	75	586	32	27
16	67	65	616	34	30
17	63	54	646	36	33
18	60	43	677	37	36
19	56	33	707	39	39
20	8.509 3952	8.511 6822	1.13737	2.3141	5.8841
21	49	11	767	42	44
22	45	00	797	44	47
23	42	8.511 6790	827	46	50
24	38	79	857	47	53
25	35	68	887	49	55
26	31	57	917	51	58
27	27	47	947	52	61
28	24	36	977	54	64
29	20	25	1.14007	56	67
30	8.509 3917	8.511 6714	1.14037	2.3157	5.8870
31	13	04	067	59	72
32	09	8.511 6693	097	61	75
33	06	82	127	62	78
34	02	71	157	64	81
35	8.509 3899	61	187	66	84
36	95	50	217	67	87
37	92	39	247	69	89
38	88	28	277	70	92
39	84	17	307	72	95
40	8.509 3881	8.511 6607	1.14337	2.3174	5.8898
41	77	8.511 6596	366	75	5.8901
42	73	85	396	77	04
43	70	74	426	79	06
44	66	63	456	80	09
45	63	52	486	82	12
46	59	42	516	83	15
47	55	31	545	85	18
48	52	20	575	87	21
49	48	09	605	88	23
50	8.509 3845	8.511 6498	1.14635	2.3190	5.8926
51	41	87	664	92	29
52	37	76	694	93	32
53	34	66	724	95	35
54	30	55	751	96	38
55	26	44	783	98	40
56	23	33	813	2.3200	43
57	19	22	843	01	46
58	16	11	872	03	49
59	12	00	902	04	52
60	8.509 3808	8.511 6389	1.14932	2.3206	5.8955

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 29°.

Latitude.	log. A diff. 1″=—0.06	log. B diff. 1″=—0.18	log. C diff. 1″=+0.49	log. D diff. 1″=+0.03	log. E diff. 1″=+0.05
° ′					
29 00	8.509 3808	8.511 6389	1.14932	2.3206	5.8955
1	05	78	961	08	58
2	01	68	991	09	60
3	8.509 3797	57	1.15021	11	63
4	94	46	050	12	66
05	90	35	080	14	69
6	86	24	109	15	72
7	83	13	139	17	75
8	79	02	168	19	78
9	76	8.511 6291	198	20	80
10	8.509 3772	8.511 6280	1.15228	2.3222	5.8983
11	68	69	257	23	86
12	65	58	287	25	89
13	61	47	316	26	92
14	57	36	346	28	95
15	54	26	375	30	98
16	50	15	405	31	5.9000
17	46	04	434	33	03
18	43	8.511 6193	464	34	06
19	39	82	493	36	09
20	8.509 3735	8.511 6171	1.15522	2.3237	5.9012
21	32	60	552	39	15
22	28	49	581	40	18
23	24	38	611	42	21
24	21	27	640	43	23
25	17	16	670	45	26
26	13	05	699	47	29
27	10	8.511 6094	728	48	32
28	06	83	758	50	35
29	02	72	787	51	38
30	8.509 3699	8.511 6061	1.15816	2.3253	6.9041
31	95	50	846	54	43
32	91	39	875	56	46
33	88	28	904	57	49
34	84	17	934	59	62
35	80	06	963	60	55
36	77	8.511 5995	992	62	58
37	73	84	1.16021	63	61
38	69	73	051	65	64
39	66	61	080	66	67
40	8.509 3662	8.511 5950	1.16109	2.3268	5.9069
41	58	39	138	69	72
42	55	28	167	71	75
43	51	17	197	72	78
44	47	06	226	74	81
45	44	8.511 5895	255	75	84
46	40	84	284	77	87
47	36	73	313	78	90
48	33	62	343	80	93
49	29	51	372	81	96
50	8.509 3625	8.511 5840	1.16401	2.3283	5.9098
51	21	29	430	84	5.9101
52	18	18	459	86	04
53	14	06	488	87	07
54	10	8.511 5795	517	89	10
55	07	84	546	90	13
56	03	73	575	92	16
57	8.509 3599	62	604	93	19
58	96	51	633	95	22
59	92	40	663	96	25
60	8.509 3588	8.511 5729	1.16692	2.3298	5.9127

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 30°.

Latitude.	log. A diff. 1″ = −0.06	log. B diff. 1″ = −0.19	log. C diff. 1″ = +0.48	log. D diff. 1″ = +0.02	log. E diff. 1″ = +0.05
° ′					
30 00	8.509 3588	8.511 5729	1.16692	2.3298	5.9127
1	84	18	721	99	30
2	81	06	750	2.3301	33
3	77	8.511 5695	778	02	36
4	73	84	807	04	39
05	69	73	836	05	42
6	66	62	865	06	45
7	62	51	894	08	48
8	58	40	923	09	51
9	55	28	952	11	54
10	8.509 3551	8.511 5617	1.16981	2.3312	5.9157
11	47	06	1.17010	14	59
12	43	8.511 5595	039	15	62
13	40	84	068	17	65
14	36	73	097	18	68
15	32	61	126	19	71
16	29	50	155	21	74
17	25	39	184	22	77
18	21	28	212	24	80
19	17	17	241	25	83
20	8.509 3514	8.511 5505	1.17270	2.3327	5.9186
21	10	8.511 5494	299	28	89
22	06	83	328	30	92
23	02	72	357	31	95
24	8.509 3499	61	385	32	98
25	95	49	414	34	5.9200
26	91	38	443	35	03
27	88	27	472	37	06
28	84	16	500	38	09
29	80	04	529	39	12
30	8.509 3476	8.511 5393	1.17558	2.3341	5.9215
31	72	82	587	42	18
32	69	71	615	44	21
33	65	59	644	45	24
34	61	48	673	47	27
35	57	37	701	48	30
36	54	26	730	49	33
37	50	14	759	51	36
38	46	03	788	52	39
39	42	8.611 5292	816	54	42
40	8.509 3439	8.511 5281	1.17845	2.3355	5.9245
41	35	69	874	56	48
42	31	58	902	58	51
43	27	47	931	59	53
44	24	35	959	60	56
45	20	24	988	62	59
46	16	13	1.18017	63	62
47	12	02	045	65	65
48	09	8.511 5190	074	66	68
49	05	79	102	67	71
50	8.509 3401	8.511 5168	1.18131	2.3368	5.9274
51	8.509 3397	56	160	70	77
52	94	45	188	71	80
53	90	34	217	73	83
54	86	22	245	74	86
55	82	11	274	76	89
56	78	00	302	77	92
57	75	8.511 5088	331	78	95
58	71	77	359	80	98
59	67	66	388	81	5.9301
60	8.509 3363	8.511 5054	1.18416	2.3382	5.9304

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 31°.

Latitude.	log. A diff. 1″=—0.06	log. B diff. 1″=—0.19	log. C diff. 1″=+0.47	log. D diff. 1″=+0.02	log. E diff. 1″=+0.05
° ′					
31 00	8.509 3363	8.511 5054	1.18416	2.3382	5.9304
1	60	43	445	84	07
2	56	32	473	85	10
3	52	20	501	86	13
4	48	09	530	88	16
05	44	8.511 4998	558	89	19
6	41	86	587	90	22
7	37	75	615	92	25
8	33	64	643	93	28
9	29	52	672	95	31
10	8.509 3325	8.511 4941	1.18700	2.3396	5.9334
11	22	29	729	97	37
12	18	18	757	99	39
13	14	07	785	2.3400	42
14	10	8.511 4895	813	01	45
15	06	84	842	02	48
16	03	72	870	04	51
17	8.509 3299	61	898	05	64
18	95	50	927	06	57
19	91	38	955	08	60
20	8.509 3287	8.511 4827	1.18983	2.3409	5.9363
21	84	15	1.19012	10	66
22	80	04	040	12	69
23	76	8.511 4793	068	13	72
24	72	81	096	14	75
25	68	70	125	16	78
26	65	58	153	17	81
27	61	47	181	18	84
28	57	35	209	20	87
29	53	24	238	21	90
30	8.509 3249	8.511 4713	1.19266	2.3422	5.9393
31	46	01	294	23	96
32	42	8.511 4690	322	25	99
32	38	78	351	26	5.9402
34	34	67	379	27	05
35	30	55	407	29	08
36	26	44	435	30	11
37	23	32	463	31	14
38	19	21	491	33	17
39	15	09	520	34	20
40	8.509 3211	8.511 4598	1.19548	2.3435	5.9423
41	07	86	576	36	26
42	03	75	604	38	29
43	00	63	632	39	32
44	8.509 3196	52	660	40	35
45	92	40	688	41	38
46	88	29	716	43	41
47	84	17	744	44	44
48	81	06	772	45	47
49	77	8.511 4494	800	47	50
50	8.509 3173	8.511 4483	1.19828	2.3448	5.9453
51	69	71	856	49	56
52	65	60	884	50	59
53	61	48	912	52	62
54	57	37	940	53	65
55	54	25	968	54	68
56	50	14	996	55	72
57	46	02	1.20024	57	75
58	42	8.511 4391	052	58	78
59	38	79	080	59	81
60	8.509 3134	8.511 4368	1.20108	2.3460	5.9484

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 32°

Latitude.	log. A diff. 1″=−0.06	log. B diff. 1″=−0.19	log. C diff. 1″=+0.46	log. D diff. 1″=+0.02	log. E diff. 1″=+0.05
° ′					
32 00	8.509 3134	8.511 4368	1.20108	2.3460	5.9484
1	31	56	136	62	87
2	27	44	164	63	90
3	23	53	192	64	93
4	19	21	220	65	96
05	15	10	248	67	99
6	11	8.511 4298	276	68	5.9502
7	07	87	304	69	05
8	04	75	332	70	08
9	00	63	360	71	11
10	8.509 3096	8.511 4252	1.20387	2.3473	5.9514
11	92	40	415	74	17
12	88	29	443	75	20
13	84	17	471	76	23
14	80	05	499	78	26
15	76	8.511 4194	527	79	29
16	73	82	555	80	32
17	67	71	582	81	35
18	65	59	610	82	38
19	61	47	638	84	41
20	8.509 3057	8.511 4136	1.20666	2.3485	5.9544
21	53	24	694	86	47
22	49	13	722	87	50
23	46	01	749	88	53
24	42	8.511 4089	777	90	56
25	38	78	805	91	60
26	34	66	833	92	63
27	30	54	860	93	66
28	26	43	888	94	69
29	22	31	916	96	72
30	8.509 3018	8.511 4020	1.20944	2.3497	5.9575
31	15	08	971	98	78
32	11	8.511 3996	999	99	81
33	07	85	1.21027	2.3500	84
34	03	73	054	02	87
35	8.509 2999	61	082	03	90
36	95	50	110	04	93
37	91	38	137	05	96
38	87	26	165	06	99
39	83	15	193	07	5.9602
40	8.509 2980	8.511 3903	1.21220	2.3509	5.9605
41	76	8.511 3891	248	10	08
42	72	79	276	11	11
43	68	68	303	12	15
44	64	56	331	13	18
45	60	44	358	14	21
46	56	33	386	16	24
47	52	21	414	17	27
48	48	09	441	18	30
49	44	8.511 3798	469	19	33
50	8.509 2940	8.511 3786	1.21496	2.3520	5.9636
51	37	74	524	21	39
52	33	63	551	23	42
53	29	51	579	24	45
54	25	39	607	25	48
55	21	27	634	26	51
56	17	16	662	27	54
57	13	04	689	28	58
58	09	8.511 3692	717	29	61
59	05	80	744	31	64
60	8.509 2901	8.511 3669	1.21772	2.3532	5.9667

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 38°.

Latitude.	log. A	log. B	log. C	log. D	log. E
	diff. 1″=−0.07	diff. 1″=−0.20	diff. 1″=+0.45	diff. 1″=+0.02	diff. 1″=+0.05
° ′					
33 00	8.509 2901	8.511 3669	1.21772	2.3532	5.9667
1	8.509 2897	57	799	33	70
2	94	45	827	34	73
3	90	33	854	35	76
4	86	22	882	36	79
05	82	10	909	37	82
6	78	8.511 3598	937	38	85
7	74	86	964	40	88
8	70	75	992	41	92
9	66	63	1.22019	42	95
10	8.509 2862	8.511 3551	1.22047	2.3643	5.9698
11	58	39	074	44	5.9701
12	54	28	101	45	04
13	51	16	129	46	07
14	47	04	156	47	10
15	43	8.511 3492	184	49	13
16	39	80	211	50	16
17	35	69	238	51	19
18	31	57	266	52	22
19	27	45	293	53	26
20	8.509 2823	8.511 3433	1.22321	2.3554	5.9729
21	19	21	348	55	32
22	15	10	375	56	35
23	11	8.511 3398	403	57	38
24	07	86	430	58	41
25	03	74	457	60	44
26	8.609 2799	62	485	61	47
27	95	51	512	62	50
28	91	39	539	63	53
29	88	27	567	64	57
30	8.509 2784	8.511 3315	1.22594	2.3565	5.9760
31	80	03	621	66	63
32	76	8.511 3291	648	67	66
33	72	80	676	68	69
34	68	68	703	69	72
35	64	56	730	70	75
36	60	44	757	71	78
37	56	32	785	73	81
38	52	20	812	74	85
39	48	09	839	75	88
40	8.509 2744	8.511 3197	1.22866	2.3576	5.9791
41	40	85	893	77	94
42	36	73	921	78	97
43	32	61	948	79	5.9800
44	28	49	975	80	03
45	24	37	1.23002	81	06
46	20	25	029	82	10
47	16	13	057	83	13
48	12	02	084	84	16
49	08	8.511 3090	111	85	19
50	8.509 2704	8.511 3078	1.23138	2.3586	5.9822
51	01	66	165	87	25
52	8.509 2697	54	192	88	28
53	93	42	220	89	31
54	89	30	247	91	35
55	85	18	274	92	38
56	81	06	301	93	41
57	77	8.511 2995	328	94	44
58	73	83	355	95	47
59	69	71	382	96	50
60	8.509 2665	8.511 2959	1.23409	2.3597	5.9853

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 34°.

Latitude.	log. A	log. B	log. C	log. D	log. E
	diff. 1″=—0.07	diff. 1″=—0.20	diff. 1″=+0.45	diff. 1″=+0.02	diff. 1″=+0.05
° ′					
34 00	8.509 2665	8.511 2959	1.23409	2.3597	5.9853
1	61	47	437	98	57
2	57	35	464	99	60
3	53	23	491	2.3600	63
4	49	11	518	01	66
05	45	8.511 2899	545	02	69
6	41	87	572	03	72
7	37	75	599	04	75
8	33	63	626	05	79
9	30	51	653	06	82
10	8.509 2625	8.511 2840	1.23680	2,3607	5.9885
11	21	28	707	08	88
12	17	16	734	09	91
13	13	04	761	10	94
14	09	8.511 2792	788	11	97
15	05	80	815	12	5.9901
16	01	68	842	13	04
17	8.509 2597	56	869	14	07
18	93	44	896	15	10
19	89	32	923	16	13
20	8.509 2585	8.511 2720	1.23950	2.3617	5.9916
21	81	08	977	18	19
22	77	8.511 2696	1.24004	19	23
23	73	84	031	20	26
24	69	72	058	21	29
25	65	60	085	22	32
26	61	48	112	23	25
27	57	36	139	24	38
28	53	24	165	25	42
29	49	12	192	26	45
30	8.509 2545	8.511 2600	1.24219	2.3627	5.9948
31	41	8.511 2588	246	28	51
32	37	76	273	29	54
33	33	64	300	30	57
34	29	52	327	31	61
35	25	40	354	32	64
36	21	28	381	33	67
37	17	16	408	34	70
38	13	04	434	35	73
39	09	8.511 2492	461	36	76
40	8.509 2505	8.511 2480	1.24488	2.3637	5.9980
41	01	68	515	38	83
42	8.509 2497	56	542	39	86
43	93	44	569	40	89
44	89	32	595	41	92
45	85	20	622	42	96
46	81	08	649	43	99
47	77	8.511 2396	676	44	6.0002
48	73	84	703	44	05
49	69	72	729	45	08
50	8.509 2465	8.511 2360	1.24756	2.3646	6.0011
51	61	48	783	47	15
52	57	35	810	48	18
53	53	23	837	49	21
54	49	11	863	50	24
55	45	8.511 2299	890	51	27
56	41	87	917	52	31
57	37	75	944	53	34
58	33	63	970	54	37
59	29	51	997	55	40
60	8.509 2425	2.511 2239	1.25024	2.3656	6.0043

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 35°.

Latitude.	log. A	log. B	log. C	log. D	log. E
	diff. 1″=—0.07	diff. 1″=—0.20	diff. 1″=+0.44	diff, 1″=+0.01	diff. 1″=+0.05
° ′					
35 00	8.509 2425	8.511 2239	1.25024	2.3656	6.0043
1	21	27	050	57	47
2	17	15	077	58	50
3	13	03	104	59	53
4	09	8.511 2191	131	59	56
05	05	78	157	60	59
6	01	66	184	61	63
7	8.509 2396	54	211	62	66
8	93	42	237	63	69
9	88	30	264	64	72
10	8.509 2384	8.511 2118	1.25291	2.3665	6.0075
11	80	06	317	66	79
12	76	8.511 2094	344	67	82
13	72	82	371	68	85
14	68	70	397	69	88
15	64	57	424	70	91
16	60	45	451	70	95
17	56	33	477	71	98
18	52	21	504	72	6.0101
19	48	09	531	73	04
20	8.509 2344	8.511 1997	1.25557	2.3674	6.0107
21	40	85	584	75	11
22	36	72	610	76	14
23	32	60	637	77	17
24	28	48	664	78	20
25	24	36	690	79	23
26	20	24	717	79	27
27	16	12	743	80	30
28	12	00	770	81	33
29	08	8.511 1887	796	82	36
30	8.509 2304	8.511 1875	1.25823	2.3683	6.0140
31	00	63	850	84	43
32	8.509 2296	51	876	85	46
33	92	39	903	86	49
34	87	27	929	86	52
35	83	15	956	87	56
36	79	02	982	88	59
37	75	8.511 1790	1.26009	89	62
38	71	78	035	90	65
39	67	66	062	91	69
40	8.509 2263	8.511 1754	1.26088	2.3692	6.0172
41	59	41	115	93	75
42	55	29	141	93	78
43	51	17	168	94	81
44	47	05	194	95	85
45	43	8.511 1693	221	96	88
46	39	80	247	97	91
47	35	68	274	98	94
48	31	56	300	99	98
49	27	44	327	99	6.0201
50	8.509 2222	8.511 1632	1.26353	2.3700	6.0204
51	18	20	380	01	07
52	14	07	406	02	11
53	10	8.511 1595	432	03	14
54	06	83	459	04	17
55	02	71	485	05	20
56	8.509 2198	58	512	05	24
57	94	46	538	06	27
58	90	34	565	07	30
59	86	22	591	08	33
60	8.509 2182	8.511 1510	1.26617	2.3709	6.0237

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 36°

Latitude.	log. A diff. 1″ = −0.07	log. B diff. 1″ = −0.20	log. C diff. 1″ = +0.44	log. D diff. 1″ = +0.01	log. E diff. 1″ = +0.05
° ′					
36 00	8.509 2182	8.511 1510	1.26617	2.3709	6.0237
1	78	8.511 1497	644	10	40
2	74	85	670	10	43
3	70	73	697	11	46
4	65	61	723	12	50
05	61	48	749	13	53
6	57	36	776	14	56
7	53	24	802	14	59
8	49	12	828	15	63
9	45	8.511 1399	855	16	66
10	8.509 2141	8.511 1387	1.26881	2.3717	6.0269
11	37	75	908	18	72
12	33	63	934	19	76
13	29	50	960	19	79
14	25	38	987	20	82
15	21	26	1.27013	21	85
16	16	14	039	22	89
17	12	01	066	23	92
18	08	8.511 1289	092	23	95
19	04	77	118	24	99
20	8.509 2100	8.511 1265	1.27145	2.3725	6.0302
21	8.509 2096	52	171	26	05
22	92	40	197	27	08
23	88	28	223	27	12
24	84	15	250	28	15
25	80	03	276	29	18
26	75	8.511 1191	302	30	21
27	71	79	329	31	25
28	67	66	355	31	28
29	63	54	381	32	31
30	8.509 2059	8.511 1142	1.27407	2.3733	6.0334
31	55	29	434	34	38
32	51	17	460	35	41
33	47	05	486	35	44
34	43	8.511 1092	512	36	48
35	39	80	539	37	51
36	35	68	565	38	54
37	30	56	591	38	57
38	26	43	617	39	61
39	22	31	644	40	64
40	8.509 2018	8.511 1019	1.27670	2.3741	6.0367
41	14	06	696	41	71
42	10	8.511 0994	722	42	74
43	06	82	748	43	77
44	02	69	775	44	80
45	8.509 1998	57	801	45	84
46	93	45	827	45	87
47	89	32	853	46	90
48	85	20	879	47	94
49	81	08	905	48	97
50	8.509 1977	8.511 0895	1.27932	2.3748	6.0400
51	73	83	958	49	03
52	69	71	984	50	07
53	65	58	1.28010	51	10
54	61	46	036	51	13
55	56	34	062	52	17
56	52	21	088	53	20
57	48	09	114	54	23
58	44	8.511 0797	141	54	27
59	40	84	167	55	30
60	8.509 1936	8.511 0772	1.28193	2.3756	6.0433

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 37°.

Latitude.	log. A	log. B	log. C	log. D	log. E
	diff. 1″=−0. 07	diff. 1″=−0. 21	diff. 1″=+0. 43	diff. 1″=+0. 01	diff. 1″=+0. 06
° ′					
37 00	8. 509 1936	8. 511 0772	1. 28193	2. 3756	6. 0433
1	32	60	219	56	37
2	28	47	245	57	40
3	23	35	271	58	43
4	19	22	297	59	46
05	15	10	324	59	50
6	11	8. 511 0698	350	60	53
7	07	85	376	61	56
8	03	73	402	62	60
9	8. 509 1899	61	428	62	63
10	8. 509 1895	8. 511 0648	1. 28454	2. 3763	6. 0466
11	90	36	480	64	70
12	86	23	506	65	73
13	82	11	532	65	76
14	78	8. 511 0599	558	66	80
15	74	86	584	67	83
16	70	74	610	67	86
17	66	61	636	68	89
18	62	49	662	69	93
19	57	37	688	69	96
20	8. 509 1853	8. 511 0524	1. 28715	2. 3770	6. 0499
21	49	12	741	71	6. 0503
22	45	00	767	72	06
23	41	8. 511 0487	793	72	09
24	37	75	819	73	13
25	33	62	845	74	16
26	28	50	871	74	19
27	24	37	897	75	23
28	20	25	923	76	26
29	16	13	949	76	29
30	8. 509 1812	8. 511 0400	1. 28975	2. 3777	6. 0533
31	08	8. 511 0388	1. 29001	78	36
32	04	75	027	79	39
33	00	63	053	79	43
34	8. 509 1795	51	079	80	46
35	91	38	104	81	49
36	87	26	130	81	53
37	83	13	156	82	56
38	79	01	182	83	59
39	75	8. 511 0288	208	83	63
40	8. 509 1771	8. 511 0276	1. 29234	2. 3784	6. 0566
41	66	64	260	85	69
42	62	51	286	85	73
43	58	39	312	86	76
44	54	26	338	87	79
45	50	14	364	87	83
46	46	01	390	88	86
47	41	8. 511 0189	416	89	89
48	37	76	442	89	93
49	33	64	468	90	96
50	8. 509 1729	8. 511 0151	1. 29494	2. 3791	6. 0600
51	25	39	520	91	03
52	21	26	546	92	06
53	16	14	571	93	10
54	12	02	597	93	13
55	08	8. 511 0089	623	94	16
56	04	77	649	95	20
57	00	64	675	95	23
58	8. 509 1696	52	701	96	26
59	92	39	727	96	30
60	8. 509 1687	8. 511 0027	1. 29753	2. 3797	6. 0633

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 38°.

Latitude.	log. A	log. B	log. C	log. D	log. E
	diff. 1″=—0.07	diff. 1″=—0.21	diff. 1″=+0.43	diff. 1″=+0.01	diff. 1″=+0.06
° ′					
38 00	8.509 1687	8.511 0027	1.29753	2.3797	6.0633
1	83	14	778	98	36
2	79	02	804	98	40
3	75	8.510 9989	830	99	43
4	71	77	856	2.3800	47
05	67	64	882	00	50
6	62	52	908	01	53
7	58	39	934	02	57
8	54	27	959	02	60
9	50	14	985	03	63
10	8.509 1646	8.510 9902	1.30011	2.3803	6.0667
11	42	8.510 9889	037	04	70
12	37	77	063	05	73
13	33	64	089	05	77
14	29	52	114	06	80
15	25	39	140	07	84
16	21	27	166	07	87
17	17	14	192	08	90
18	12	02	218	08	94
19	08	8.510 9789	243	09	97
20	8.509 1604	8.510 9777	1.30269	2.3810	6.0701
21	00	64	295	10	04
22	8.509 1596	52	321	11	07
23	92	39	347	12	11
24	87	27	372	12	14
25	83	14	398	13	17
26	79	01	424	13	21
27	75	8.510 9689	450	14	24
28	71	77	476	15	28
29	66	64	501	15	31
30	8.509 1562	8.510 9652	1.30527	2.3816	6.0734
31	58	39	553	16	38
32	54	27	579	17	41
33	50	14	604	17	44
34	46	01	630	18	48
35	41	8.510 9589	656	19	51
36	37	76	682	19	55
37	33	64	707	20	58
38	29	51	733	20	61
39	25	39	759	21	65
40	8.509 1521	8.510 9526	1.30785	2.3822	6.0768
41	16	14	810	22	72
42	12	01	836	23	75
43	08	8.510 9488	862	23	78
44	04	76	887	24	82
45	00	63	913	24	85
46	8.509 1495	51	939	25	89
47	91	38	965	26	92
48	87	26	990	26	95
49	83	13	1.31016	27	99
50	8.509 1479	8.510 9401	1.31042	2.3827	6.0802
51	75	8.510 9388	067	28	06
52	70	76	093	28	09
53	66	63	119	29	13
54	62	50	144	30	16
55	58	38	170	30	19
56	53	25	196	31	23
57	49	13	221	31	26
58	45	00	247	32	30
59	41	8.510 9287	273	32	33
60	8.509 1437	8.510 9275	1.31299	2.3833	6.0836

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 39°.

Latitude.	log A	log B	log C	log D	log E
	diff. 1″=—0.07	diff. 1″=—0.21	diff. 1″=+0.43	diff. 1″=+0.01	diff. 1″=+0.06
° ′					
39 00	8.509 1437	8.510 9275	1.31299	2.3833	6.0836
1	33	62	324	33	40
2	28	50	350	34	43
3	24	37	375	35	47
4	20	25	401	35	50
05	16	12	427	36	53
6	12	8.510 9199	452	36	57
7	07	87	478	37	60
8	03	74	504	37	64
9	8.509 1399	62	529	38	67
10	8.509 1395	8.510 9149	1.31555	2.3838	6.0871
11	91	36	581	39	74
12	86	24	606	39	77
13	82	11	632	2.3840	81
14	78	8.510 9098	658	40	84
15	74	86	683	41	88
16	70	73	709	41	91
17	65	61	734	42	95
18	61	48	760	43	98
19	57	36	786	43	6.0902
20	8.509 1353	8.510 9023	1.31811	2.3844	6.0905
21	49	10	837	44	08
22	44	8.510 8998	862	45	12
23	40	85	888	45	15
24	36	73	913	46	19
25	32	60	939	46	22
26	28	47	965	47	26
27	23	35	990	47	29
28	19	22	1.32016	48	32
29	15	09	041	48	36
30	8.509 1311	8.510 8897	1.32067	2.3849	6.0939
31	07	84	092	49	43
32	02	72	118	2.3850	46
33	8.509 1298	59	144	50	50
34	94	46	169	51	53
35	90	34	195	51	57
36	86	21	220	52	60
37	81	08	246	52	63
38	77	8.510 8796	271	53	67
39	73	83	297	53	70
40	8.509 1269	8.510 8771	1.32323	2.3854	6.0974
41	64	58	348	54	77
42	60	45	374	55	81
43	56	33	399	55	84
44	52	20	425	56	88
45	48	07	450	56	91
46	43	8.510 8695	476	57	95
47	39	82	501	57	98
48	35	69	527	57	6.1002
49	31	57	552	58	05
50	8.509 1227	8.510 8644	1.32578	2.3858	6.1008
51	22	31	603	59	12
52	18	19	629	59	15
53	14	06	654	2.3860	19
54	10	8.510 8593	680	60	22
55	06	81	705	61	26
56	01	68	731	61	29
57	8.509 1197	55	756	62	33
58	93	43	782	62	36
59	89	30	807	63	40
60	8.509 1184	8.510 8517	1.32833	2.3863	6.1043

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 40°.

Latitude.	log **A** diff. 1″ = −0.07	log **B** diff. 1″ = −0.21	log **C** diff. 1″ = + 0.42	log **D** diff. 1″ = + 0.01	log **E** diff. 1″ = + 0.06
° ′					
40 00	8.509 1184	8.510 8517	1.32833	2.3863	6.1043
1	80	05	858	64	47
2	76	8.510 8492	884	64	50
3	72	79	909	64	54
4	67	67	935	65	57
05	63	54	960	65	61
6	59	41	986	66	64
7	55	29	1.33011	66	67
8	50	16	037	67	71
9	46	03	062	67	74
10	8.509 1142	8.510 8391	1.33088	2.3868	6.1078
11	38	78	113	68	81
12	34	65	139	68	85
13	29	53	164	69	88
14	25	40	189	69	92
15	21	27	215	2.3870	95
16	17	15	240	70	99
17	12	02	266	71	6.1102
18	08	8.510 8289	291	71	06
19	04	77	317	72	09
20	8.509 1100	8.510 8264	1.33342	2.3872	6.1113
21	8.509 1096	51	368	72	16
22	91	38	393	73	20
23	87	26	418	73	23
24	83	13	444	74	27
25	79	00	469	74	30
26	74	8.510 8188	495	74	34
27	70	75	520	75	37
28	66	62	546	75	41
29	62	50	571	76	44
30	8.509 1057	8.510 8137	1.33596	2.3876	6.1148
31	53	24	622	77	51
32	49	11	647	77	55
33	45	8.510 8099	673	77	58
34	41	86	698	78	62
35	36	73	723	78	65
36	32	61	749	79	69
37	28	48	774	79	72
38	24	35	800	79	76
39	19	23	825	2.3880	79
40	8.509 1015	8.510 8010	1.33850	2.3880	6.1183
41	11	8.510 7997	876	81	86
42	07	84	901	81	90
43	02	72	926	81	93
44	8.509 0998	59	952	82	97
45	94	46	977	82	6.1200
46	90	33	1.34003	83	04
47	85	21	028	83	07
48	81	08	053	83	11
49	77	8.510 7895	079	84	15
50	8.509 0973	8.510 7883	1.34104	2.3884	6.1218
51	68	70	129	84	22
52	64	57	155	85	25
53	60	44	180	85	29
54	56	32	206	86	32
55	52	19	231	86	36
56	47	06	256	86	39
57	43	8.510 7793	282	87	43
58	39	81	307	87	46
59	34	68	332	87	50
60	8.509 0930	8.510 7755	1.34358	2.3888	6.1253

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 41°.

Latitude.	log. A	log. B	log. C	log. D	log. E
	diff. 1″=−0.07	diff. 1″=−0.21	diff. 1″=+0.42	diff. 1″=+0.01	diff. 1″=+0.06
° ′					
41 00	8.509 0930	8.510 7755	1.34358	2.3888	6.1253
1	26	42	383	88	57
2	22	30	408	89	60
3	18	17	434	89	64
4	13	04	459	89	67
05	09	8.510 7691	484	90	71
6	05	79	510	90	75
7	00	66	535	90	78
8	8.509 0896	53	560	91	82
9	92	40	586	91	85
10	8.509 0888	8.510 7628	1.34611	2.3891	6.1289
11	83	15	636	92	92
12	79	02	662	92	96
13	75	8.510 7590	687	93	99
14	71	77	712	93	6.1303
15	67	64	738	93	06
16	62	51	763	94	10
17	58	39	788	94	14
18	54	26	814	94	17
19	49	13	839	95	21
20	8.509 0845	8.510 7500	1.34864	2.3895	6.1324
21	41	8.510 7488	890	95	28
22	37	75	915	96	31
23	32	62	940	96	35
24	28	49	965	96	38
25	24	36	991	97	42
26	20	24	1.35016	97	46
27	15	11	041	97	49
28	11	8.510 7398	066	98	53
29	07	85	092	98	56
30	8.509 0803	8.510 7373	1.35117	2.3898	6.1360
31	8.509 0798	60	142	99	63
32	94	47	168	99	67
33	90	34	193	99	70
34	86	22	218	2.3900	74
35	81	09	243	00	78
36	77	8.510 7296	269	00	81
37	73	83	294	00	85
38	69	70	319	01	88
39	64	58	345	01	92
40	8.509 0760	8.510 7245	1.35370	2.3901	6.1395
41	56	32	395	02	99
42	52	19	420	02	6.1403
43	47	07	446	02	06
44	43	8.510 7194	471	03	10
45	39	81	496	03	13
46	35	68	522	03	17
47	30	55	547	03	20
48	26	43	572	04	24
49	22	30	597	04	28
50	8.509 0718	8.510 7117	1.35623	2.3904	6.1431
51	13	04	648	05	35
52	09	8.510 7091	673	05	38
53	05	79	698	05	42
54	00	66	723	05	46
55	8.509 0696	53	749	06	49
56	92	40	774	06	53
57	88	27	799	06	56
58	83	15	824	07	60
59	79	02	850	07	63
60	8.509 0675	8.510 6989	1.35875	2.3907	6.1467

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 42°

Latitude.	log. A diff. 1″=—0.07	log. B diff. 1″=—0.21	log. C diff. 1″=+0.42	log D. diff. 1″=+0.00	log. E diff. 1″=+0.06
° ′					
42 00	8.509 0675	8.510 6989	1.35875	2.3907	6.1467
1	71	76	900	08	71
2	66	64	925	08	74
3	62	51	951	08	78
4	58	38	976	08	81
05	54	25	1.36001	09	85
6	49	12	026	09	89
7	45	00	052	09	92
8	41	8.510 6887	077	09	96
9	36	74	102	10	99
10	8.569 0632	8.510 6861	1.36127	2.3910	6.1503
11	28	48	152	10	07
12	24	36	178	10	10
13	19	23	203	11	14
14	15	10	228	11	17
15	11	8.510 6797	253	11	21
16	07	84	278	12	25
17	02	72	304	12	28
18	8.509 0598	59	329	12	32
19	94	46	354	12	35
20	8.509 6590	8.510 6733	1.36379	2.3913	6.1539
21	85	20	404	13	43
22	81	07	430	13	46
23	77	8.510 6695	455	13	50
24	72	82	480	13	54
25	68	69	505	14	57
26	64	56	530	14	61
27	60	43	556	14	64
28	55	31	581	14	68
29	51	18	606	15	72
30	8.509 0547	8.510 6605	1.36631	2.3915	6.1575
31	43	8.510 6592	656	15	79
32	38	79	682	15	83
33	34	66	707	16	86
34	30	54	732	16	90
35	25	41	757	16	93
36	21	28	782	16	97
37	17	15	808	17	6.1601
38	13	02	833	17	04
39	08	8.510 6490	858	17	08
40	8.509 0504	8.510 6477	1.36883	2.3917	6.1612
41	00	64	908	17	15
42	8.509 0496	51	934	18	19
43	91	38	959	18	22
44	87	25	984	18	26
45	83	13	1.37009	18	30
46	78	00	034	19	33
47	74	8.510 6387	059	19	37
48	70	74	085	19	41
49	66	61	110	19	44
50	8.509 0461	8.510 6348	1.37135	2.3919	6.1648
51	57	36	160	20	52
52	53	23	185	20	55
53	48	10	210	20	59
54	44	8.510 6297	235	20	63
55	40	84	261	20	66
56	36	71	286	21	70
57	31	59	311	21	73
58	27	46	336	21	77
59	23	33	361	21	81
60	8.509 0419	8.510 6220	1.37386	2.3921	6.1684

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 43°.

Latitude.	log. A diff. 1″=−0.07	log. B diff. 1″=−0.21	log. C diff. 1″=+0.42	log. D diff. 1″=+0.00	log. E diff. 1″=+0.06
° ′					
43 00	8.509 0419	8.519 6220	1.37386	2.3921	6.1684
1	14	07	412	22	88
2	10	8.510 6195	437	22	92
3	06	82	462	22	95
4	01	69	487	22	99
05	8.509 0397	56	512	22	6.1703
6	93	43	537	22	06
7	89	30	563	23	10
8	84	17	588	23	14
9	80	05	613	23	17
10	8.509 0376	8.510 6092	1.37638	2.3923	6.1721
11	71	79	663	23	25
12	67	66	688	24	28
13	63	53	713	24	32
14	59	40	739	24	36
15	54	28	764	24	39
16	50	15	789	24	43
17	46	02	814	24	47
18	41	8.510 5989	839	25	50
19	37	76	864	25	54
20	8.509 0333	8.510 5963	1.37889	2.3925	6.1758
21	29	50	915	25	61
22	24	38	940	25	65
23	20	25	965	25	69
24	16	12	990	25	72
25	12	8.510 5899	1.38015	26	76
26	07	86	040	26	80
27	03	73	065	26	83
28	8.509 0299	60	091	26	87
29	94	48	116	26	91
30	8.509 0290	8.510 5835	1.38141	2.3926	6.1795
31	86	22	166	27	98
32	82	09	191	27	6.1802
33	77	8.510 5796	216	27	06
34	73	83	241	27	09
35	69	71	266	27	13
36	64	58	292	27	17
37	60	45	317	27	20
38	56	32	342	27	24
39	52	19	367	28	28
40	8.509 0247	8.510 5706	1.38392	2.3928	6.1831
41	43	8.510 5693	417	28	35
42	39	81	442	28	39
43	34	68	467	28	42
44	30	55	492	28	46
45	26	42	518	28	50
46	22	29	543	28	53
47	17	16	568	29	57
48	13	03	593	29	61
49	09	8.510 5591	618	29	65
50	8.509 0204	8.510 5578	1.38643	2.3929	6.1868
51	00	65	668	29	72
52	8.509 0196	52	693	29	76
53	92	39	719	29	79
54	87	26	744	29	83
55	83	13	769	30	87
56	79	01	794	30	91
57	74	8.510 5488	819	30	94
58	70	75	844	30	98
59	66	62	869	30	6.1902
60	8.509 0162	8.510 5449	1.38894	2.3930	6.1905

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 44°.

Latitude.	log. A	log. B	log. C	log. D	log. E
	diff. 1″=−0.07	diff. 1″=−0.21	diff. 1″=+0.42	diff. 1″=+0.00	diff. 1″=+0.06
° ′					
44 00	8. 509 0162	8. 510 5449	1. 38894	2. 3930	6. 1905
1	57	36	919	30	09
2	53	23	945	30	13
3	49	01	970	30	17
4	44	8. 510 5388	995	30	20
05	40	75	1. 39020	31	24
6	36	62	045	31	28
7	31	49	070	31	31
8	27	36	095	31	35
9	23	23	120	31	39
10	3. 509 0119	8. 510 5311	1. 39145	2. 3931	6. 1943
11	14	07	171	31	46
12	10	8. 510 5295	196	31	50
13	06	82	221	31	54
14	02	69	246	31	58
15	8. 509 0097	56	271	31	61
16	93	43	296	31	65
17	89	30	321	32	69
18	84	18	346	32	72
19	80	05	371	32	76
20	8. 509 0076	9. 510 5192	1. 39396	2. 3932	6. 1980
21	72	79	422	32	84
22	67	66	447	32	87
23	63	53	472	32	91
24	59	40	497	52	95
25	54	28	522	32	99
26	50	15	547	32	6. 2002
27	46	02	572	32	06
28	42	8. 510 5089	597	32	10
29	37	76	623	32	14
30	8. 509 0033	8. 510 5063	1. 39648	2. 3932	6. 2017
31	29	50	673	32	21
32	24	37	698	32	25
33	20	25	723	33	29
34	16	12	748	33	32
35	11	8. 510 4999	773	33	36
36	07	86	798	33	40
37	03	73	823	33	44
38	8. 508 9999	60	848	33	47
39	94	47	873	33	51
40	8. 508 9990	8. 510 4935	1. 39898	2. 3933	6. 2055
41	86	22	924	33	59
42	81	09	949	33	62
43	77	8. 510 4896	974	33	66
44	73	83	999	33	70
45	69	70	1. 40024	33	74
46	64	57	049	33	77
47	60	44	074	33	81
48	56	32	099	33	85
49	51	19	124	33	89
50	8. 508 9947	8. 510 4806	1. 40149	2. 3933	6. 2092
51	43	8. 510 4793	174	33	96
52	39	80	200	33	6. 2100
53	34	67	225	33	04
54	30	54	250	33	08
55	26	41	275	33	11
56	21	29	300	33	15
57	17	16	325	33	19
58	13	03	350	33	23
59	09	8. 510 4690	375	33	27
60	8. 508 9904	8. 510 4677	1. 40400	2. 3933	6. 2130

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 45°.

Latitude.	log. A	log. B	log. C	log. D	log. E
	diff. 1″ = −0.07	diff. 1″ = −0.21	diff. 1″ = +0.42	diff. 1″ = ±0.00	diff. 1″ = +0.06
° ′					
45 00	8.508 9904	8.510 4677	1.40400	2.3933	6.2130
1	00	64	425	33	34
2	8.508 9896	51	450	33	38
3	91	39	475	34	42
4	87	26	501	34	46
05	83	13	526	34	49
6	78	00	551	34	53
7	74	8.510 4587	576	34	57
8	70	74	601	34	61
9	66	61	626	34	64
10	8.508 9861	8.510 4548	1.40651	2.3934	6.2168
11	57	36	676	34	72
12	53	23	701	34	76
13	48	10	727	34	80
14	44	8.510 4497	752	34	83
15	40	84	777	33	87
16	36	71	802	33	91
17	31	59	827	33	95
18	27	46	852	33	99
19	23	33	877	33	6.2202
20	8.508 9818	8.510 4420	1.40902	2.3933	6.2206
21	14	07	927	33	10
22	10	8.510 4394	952	33	14
23	06	81	978	33	18
24	01	68	1.41003	33	21
25	8.508 9797	56	028	33	25
26	93	43	053	33	29
27	88	30	078	33	33
28	84	17	103	33	37
29	80	04	128	33	40
30	8.508 9776	8.510 4291	1.41153	2.3933	6.2244
31	71	78	178	33	48
32	67	65	203	33	52
33	63	52	229	33	56
34	58	40	254	33	60
35	54	27	279	33	63
36	50	14	304	33	67
37	46	01	329	33	71
38	41	8.510 4188	354	33	75
39	37	75	379	33	79
40	8.508 9733	8.510 4162	1.41404	2.3933	6.2283
41	28	49	429	33	86
42	24	37	454	33	90
43	20	24	479	33	94
44	16	11	505	33	98
45	11	8.510 4098	530	33	6.2302
46	07	85	555	32	06
47	03	72	580	32	09
48	8.508 9698	60	605	32	13
49	94	47	630	32	17
50	8.508 9690	8.510 4034	1.41655	2.3932	6.2321
51	86	21	680	32	25
52	82	08	705	32	29
53	78	8.510 3995	731	22	32
54	74	82	756	32	36
55	69	69	781	32	40
56	64	57	806	32	44
57	60	44	831	32	48
58	55	31	856	32	52
59	51	18	881	32	55
60	8.508 9647	8.510 3905	1.41906	2.3932	6.2359

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 46°.

Latitude.	log. A diff. 1″=—0.07	log. B diff. 1″=—0.21	log. C diff. 1″=+0.42	log. D diff. 1″=—0.00	log. E diff. 1″=+0.06
° ′					
46 00	8.508 9647	8.510 3905	1.41906	2.3932	6.2359
1	43	8.510 3892	931	32	63
2	38	79	957	31	67
3	34	67	982	31	71
4	30	54	1.42007	31	75
05	25	41	032	31	79
6	21	28	057	31	82
7	17	15	082	31	86
8	13	02	107	31	90
9	08	8.510 3789	132	31	94
10	8.508 9604	8.510 3776	1.42157	2.3931	6.2398
11	00	64	183	31	6.2402
12	8.508 9595	51	208	31	06
13	91	38	233	30	09
14	87	25	258	30	13
15	83	12	283	30	17
16	78	8.510 3699	308	30	21
17	74	86	333	30	25
18	70	74	358	30	29
19	65	61	384	30	33
20	8.508 9561	8.510 3648	1.42409	2.3930	6.2436
21	57	35	434	30	40
22	53	22	459	30	44
23	48	09	484	29	48
24	44	8.510 3596	509	29	52
25	40	84	534	29	56
26	35	71	559	29	60
27	31	58	584	29	64
28	27	45	610	29	67
29	23	32	635	29	71
30	8.508 9518	8.510 3519	1.42660	2.3929	6.2475
31	14	06	685	29	79
32	10	8.510 3494	710	28	83
33	05	81	735	28	87
34	01	68	760	28	91
35	8.508 9497	55	786	28	95
36	93	42	811	28	99
37	88	29	836	28	6.2502
38	84	17	861	28	06
39	80	04	886	28	10
40	8.508 9475	8.510 3391	1.42911	2.3927	6.2514
41	71	78	936	27	18
42	67	65	961	27	22
43	63	52	987	27	26
44	58	39	1.43012	27	30
45	54	27	037	27	34
46	50	14	062	27	38
47	45	01	087	26	41
48	41	8.510 3288	112	26	45
49	37	75	137	26	49
50	8.508 9433	8.510 3262	1.43163	2.3926	6.2553
51	28	49	188	26	57
52	24	37	213	26	61
53	20	24	238	26	65
54	16	11	263	25	69
55	11	8.510 3198	288	25	73
56	07	85	314	25	77
57	03	72	339	25	81
58	8.508 9398	60	364	25	84
59	94	47	389	25	88
60	8.508 9390	8.510 3134	1.43414	2.3924	6.2592

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 47°.

Latitude.	log. A	log. B	log. C	log. D	log. E
	diff. 1″=−0.07	diff. 1″=−0.21	diff. 1″=+0.42	diff. 1″=−0.00	diff. 1″=+0.07
° ′					
47 00	8.508 9390	8.510 3134	1.43414	2.3924	6.2592
1	86	21	439	24	96
2	81	08	465	24	6.2600
3	77	8.510 3095	490	24	04
4	73	82	515	24	08
05	68	70	540	24	12
6	64	57	565	23	16
7	60	44	590	23	20
8	56	31	615	23	24
9	51	18	641	23	28
10	8.508 9347	8.510 3005	1.43666	2.3923	6.2632
11	43	8.510 2993	691	23	35
12	38	80	716	22	39
13	34	67	741	22	43
14	30	54	766	22	47
15	26	41	792	22	51
16	21	28	817	22	55
17	17	16	842	21	59
18	13	03	867	21	63
19	09	8.510 2890	892	21	67
20	8.508 9304	8.510 2877	1.43917	2.3921	6.2671
21	00	64	943	21	75
22	8.508 9296	51	968	20	79
23	91	39	993	20	83
24	87	26	1.44018	20	87
25	83	13	043	20	91
26	79	00	069	20	95
27	74	8.510 2787	094	19	99
28	70	74	119	19	6.2702
29	66	62	144	19	06
30	8.508 9261	8.510 2749	1.44169	2.3919	6.2710
31	57	36	195	19	14
32	53	23	220	18	18
33	49	10	245	18	22
34	44	8.510 2698	270	18	26
35	40	85	295	18	30
36	36	72	321	18	34
37	32	59	346	17	38
38	27	46	371	17	42
39	23	33	396	17	46
40	8.508 9219	8.510 2621	1.44421	2.3917	6.2750
41	14	08	447	16	54
42	10	8.510 2595	472	16	58
43	06	82	497	16	62
44	02	69	522	16	66
45	8.508 9197	57	547	16	70
46	93	44	573	15	74
47	89	31	598	15	78
48	84	18	623	15	82
49	80	05	648	15	86
50	8.508 9176	8.510 2493	1.44673	2.3914	6.2790
51	72	80	699	14	94
52	67	67	724	14	98
53	63	54	749	14	6.2802
54	59	41	774	13	06
55	55	28	800	13	10
56	50	16	825	13	14
57	46	03	850	13	18
58	42	8.510 2390	875	12	22
59	38	77	900	12	26
60	8.508 9133	8.510 2364	1.44926	2.3912	6.2830

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 48°.

Latitude.	log. A diff. 1″ = −0.07	log. B diff. 1″ = −0.21	log. C diff. 1″ = +0 42	log. D diff. 1″ = −0.00	log. E diff. 1″ = +0.07
° ′					
48 00	8.508 9133	8.510 2364	1.44926	2.3912	6.2830
1	29	52	951	12	34
2	25	39	976	11	38
3	20	26	1.45001	11	42
4	16	13	027	11	46
05	12	00	052	11	50
6	08	8.510 2288	077	10	54
7	03	75	102	10	58
8	8.508 9099	62	128	10	62
9	95	49	153	10	66
10	8.508 9091	8.510 2236	1.45178	2.3909	6.2870
11	86	24	203	09	74
12	82	11	229	09	78
13	78	8.510 2198	254	08	82
14	74	85	279	08	86
15	69	72	304	08	90
16	65	60	330	08	94
17	61	47	355	07	98
18	57	34	380	07	6.2902
19	52	21	406	67	06
20	8.508 9048	8.510 2108	1.45431	2.3907	6.2910
21	44	8.510 2096	456	06	14
22	39	83	481	06	18
23	35	70	507	06	22
24	31	57	532	05	26
25	27	45	557	05	30
26	22	32	582	65	34
27	18	19	608	65	38
28	14	06	633	04	42
29	10	8.510 1993	658	04	46
30	8.508 9005	8.510 1981	1.45683	2.3904	6.2950
31	61	68	709	03	54
32	8.508 8997	55	734	03	58
33	93	42	759	03	62
34	88	30	785	02	66
35	84	17	810	02	70
36	80	04	835	02	74
37	76	8.510 1891	861	02	78
38	71	78	886	01	82
39	67	66	911	01	86
40	8.508 8963	8.510 1853	1.45937	2.3901	6.2990
41	59	46	962	00	94
42	54	27	987	00	98
43	50	15	1.46012	00	6.3002
44	46	02	038	2.3899	06
45	41	8.510 1789	063	99	10
46	37	76	088	99	15
47	33	64	114	98	19
48	29	51	139	98	23
49	24	38	164	98	27
50	8.508 8920	8.510 1725	1.46190	2.3897	6.3031
51	16	13	215	97	35
52	12	00	240	97	39
53	08	8.510 1687	266	96	43
54	03	74	291	96	47
55	8.508 8899	62	316	96	51
56	95	49	342	95	55
57	90	36	367	95	59
58	86	23	392	95	63
59	82	10	418	94	67
60	8.508 8878	8.510 1598	1.46443	2.3894	6.3071

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 49°.

Latitude.	log. A	log. B	log. C	log. D	log. E
	diff. 1″=−0.07	diff. 1″=−0.21	diff. 1″=+0.42	diff. 1″=−0.01	diff. 1″=+0.07
° ′					
49 00	8.508 8878	8.510 1598	1.46443	2.3894	6.3071
1	73	85	468	94	75
2	69	72	494	93	79
3	65	59	519	93	84
4	61	47	544	93	88
05	57	34	570	92	92
6	52	21	595	92	96
7	48	08	621	92	6.3100
8	44	8.510 1496	646	91	04
9	39	83	671	91	08
10	8.508 8835	8.510 1470	1.46696	2.3891	6.3112
11	31	58	722	90	16
12	27	45	747	90	20
13	23	32	773	2.3889	24
14	18	19	798	89	28
15	14	07	824	89	32
16	10	8.510 1394	849	88	37
17	06	81	874	88	41
18	01	68	899	88	45
19	8.508 8797	56	925	87	49
20	8.508 8793	8.510 1343	1.46950	2.3887	6.3153
21	89	30	976	87	57
22	84	17	1.47001	86	61
23	80	05	026	86	65
24	76	8.510 1292	052	85	69
25	72	79	077	85	73
26	67	67	103	85	78
27	63	54	128	84	82
28	59	41	153	84	86
29	55	28	179	83	90
30	8.508 8750	8.510 1216	1.47204	2.3883	6.3194
31	46	03	230	83	98
32	42	8.510 1190	255	82	6.3202
33	38	78	281	82	06
34	33	65	306	82	10
35	29	52	331	81	15
36	25	39	357	81	19
37	21	27	382	80	23
38	16	14	408	80	27
39	12	01	433	80	31
40	8.508 8708	8.510 1088	1.47459	2.3879	6.3235
41	04	76	484	79	39
42	00	63	509	78	43
43	8.508 8695	50	535	78	47
44	91	38	560	78	52
45	87	25	586	77	56
46	83	12	611	77	60
47	78	00	637	76	64
48	74	8.510 0987	662	76	68
49	70	74	688	75	72
50	8.508 8666	8.510 0962	1.47713	2.3875	6.3276
51	61	49	738	75	81
52	57	36	764	74	85
53	53	23	789	74	89
54	49	11	815	73	93
55	45	8.510 0898	840	73	97
56	40	85	866	73	6.3301
57	36	73	891	72	05
58	32	60	917	72	09
59	28	48	942	71	14
60	8.508 8623	8.510 0835	1.47968	2.3871	6.3318

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

LATITUDE 50°.

Latitude.	log. A diff. 1″=−0.07	log. B diff. 1″=−0.21	log. C diff. 1″=×0.43	log. D diff. 1″=−0.01	log. E diff. 1″=+0.07
° ′					
50 0	8. 508 8623	8. 510 0835	1. 47968	2. 3871	6. 3318
1	19	22	993	70	22
2	15	09	1. 48019	70	26
3	11	8. 510 0797	044	70	30
4	06	84	070	69	34
05	02	71	095	69	39
6	8. 508 8598	59	121	68	43
7	94	46	146	68	47
8	90	33	172	67	51
9	85	21	197	67	55
10	8. 508 8581	8. 510 0708	1. 48223	2. 3866	6. 3359
11	77	8. 510 0695	248	66	63
12	73	83	274	66	68
13	68	70	299	65	72
14	64	57	325	65	76
15	60	45	350	64	80
16	56	32	376	64	84
17	52	19	401	63	88
18	47	07	427	63	93
19	43	8. 510 0594	452	62	97
20	8. 508 8539	8. 510 0581	1. 48478	2. 3862	6. 3401
21	35	69	504	61	05
22	30	56	529	61	09
23	26	43	555	60	14
24	22	31	580	60	18
25	18	18	606	60	22
26	14	05	631	59	26
27	09	8. 510 0493	657	59	30
28	05	80	682	58	34
29	01	67	708	58	39
30	8. 508 8497	8. 510 0455	1. 48734	2. 3857	6. 3443
31	93	42	759	57	47
32	88	29	785	56	51
33	84	17	810	56	55
34	80	04	836	55	60
35	76	8. 510 0392	861	55	64
36	71	79	887	54	68
37	67	66	913	54	72
38	63	54	938	53	76
39	59	41	964	53	81
40	8. 508 8455	8. 510 0328	1. 48989	2. 3852	6. 3485
41	50	16	1. 49015	52	89
42	46	03	041	51	93
43	42	8. 510 0291	066	51	97
44	38	78	092	50	6. 3502
45	34	65	117	50	06
46	29	53	143	49	10
47	25	40	169	49	14
48	21	27	194	48	18
49	17	15	220	48	23
50	8. 508 8413	8. 510 0202	1. 49246	2. 3847	6. 3527
51	08	8. 510 0190	271	47	31
52	04	77	297	46	35
53	00	64	322	46	40
54	8. 508 8396	52	348	45	44
55	92	39	374	45	48
56	87	27	399	44	52
57	83	14	425	44	56
58	79	01	451	43	61
59	75	8. 510 0089	476	43	65
60	8. 508 8371	8. 510 0076	1. 49502	2. 3842	6. 3569

TABLE XXVII.—*Factors for the computation of geodetic latitudes, longitudes, and azimuths*—Continued.

CORRECTIONS TO LONGITUDE FOR DIFFERENCE IN ARC AND SINE.

Log. K (—)	Log. difference.	Log. *d* M (+)	Log. K (—)	Log. difference.	Log. *d* M (+)	Log. K (—)	Log. difference.	Log. *d* M (+)
3.876	0.000 0001	2.385	4.813	0.000 0075	3.322	5.114	0.000 0300	3.623
4.026	02	2.535	4.825	080	3.334	5.120	309	3.629
4.114	03	2.623	4.834	084	3.343	5.126	318	3.635
4.177	04	2.686	4.849	089	3.358	5.132	327	3.641
4.225	05	2.734	4.860	094	3.369	5.138	336	3.647
4.265	06	2.774	4.871	098	3.380	5.144	345	3.653
4.298	07	2.807	4.882	103	3.391	5.150	354	3.659
4.327	08	2.836	4.892	108	3.401	5.156	364	3.665
4.353	09	2.862	4.903	114	3.412	5.161	373	3.670
4.376	10	2.885	4.913	119	3.422	5.167	383	3.676
4.396	11	2.905	4.922	124	3.431	5.172	392	3.681
4.415	12	2.924	4.932	130	3.441	5.178	402	3.687
4.433	13	2.942	4.941	136	3.450	5.183	412	3.692
4.449	14	2.958	4.950	142	3.459	5.188	422	3.697
4.464	15	2.973	4.959	147	3.468	5.193	433	3.702
4.478	16	2.987	4.968	153	3.477	5.199	443	3.708
4.491	17	3.000	4.976	160	3.485	5.204	453	3.713
4.503	18	3.012	4.985	166	3.494	5.209	464	3.718
4.526	20	3.035	4.993	172	3.502	5.214	474	3.723
4.548	23	3.057	5.002	179	3.511	5.219	486	3.728
4.570	25	3.079	5.010	186	3.519	5.223	497	3.732
4.591	27	3.100	5.017	192	3.526	5.228	508	3.737
4.612	30	3.121	5.025	199	3.534	5.233	519	3.742
4.631	33	3.140	5.033	206	3.542	5.238	530	3.747
4.649	36	3.158	5.040	213	3.549	5.242	541	3.751
4.667	39	3.176	5.047	221	3.556	5.247	553	3.756
4.684	42	3.193	5.054	228	3.563	5.251	565	3.760
4.701	45	3.210	5.062	236	3.571	5.256	577	3.765
4.716	48	3.225	5.068	243	3.577	5.260	588	3.769
4.732	52	3.241	5.075	251	3.584	5.265	600	3.774
4.746	56	3.255	5.082	259	3.591	5.269	613	3.778
4.761	59	3.270	5.088	267	3.597	5.273	625	3.782
4.774	63	3.283	5.095	275	3.604	5.278	637	3.787
4.788	67	3.297	5.102	284	3.611	5.282	650	3.791
4.801	71	3.310	5.108	292	3.617	5.286	663	3.795

TABLE XXVIII.—*Factors for reduction of transit observations.*

[Extracted from Appendix 14, U. S. Coast and Geodetic Survey Report for 1880.]

To find A enter left-hand column with the zenith distance; its intersection with declination column gives azimuth factor.

To find B enter right-hand column with the zenith distance; its intersection with declination column gives level factor. C is given on last line of each section of the table.

Azimuth factor A=sin ζ sec. δ. Star's declination ± δ. Inclination factor B=cos ζ sec. δ.

ζ	0°	10°	15°	20°	22°	24°	26°	28°	30°	32°	34°	36°	38°	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	50°	ζ
1°	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	.03	.03	.03	.03	89°
2	.04	.04	.04	.04	.04	.04	.04	.04	.04	.04	.04	.04	.04	.05	.05	.05	.05	.05	.05	.05	.05	.05	.05	.05	88
3	.05	.05	.05	.06	.06	.06	.06	.06	.06	.06	.06	.06	.07	.07	.07	.07	.07	.07	.07	.07	.08	.08	.08	.08	87
4	.07	.07	.07	.07	.08	.08	.08	.08	.08	.08	.08	.09	.09	.09	.09	.09	.10	.10	.10	.10	.10	.10	.11	.11	86
5	.09	.09	.09	.09	.09	.10	.10	.10	.10	.10	.10	.11	.11	.11	.11	.12	.12	.12	.12	.13	.13	.13	.13	.13	85
6	.11	.11	.11	.11	.11	.11	.12	.12	.12	.12	.13	.13	.13	.14	.14	.14	.14	.15	.15	.15	.15	.16	.16	.16	84
7	.12	.12	.13	.13	.13	.13	.14	.14	.14	.14	.15	.15	.15	.16	.16	.16	.17	.17	.17	.18	.18	.18	.19	.19	83
8	.14	.14	.14	.15	.15	.15	.16	.16	.16	.16	.17	.17	.18	.18	.18	.19	.19	.19	.20	.20	.20	.21	.21	.22	82
9	.16	.16	.16	.17	.17	.17	.17	.18	.18	.18	.19	.19	.20	.20	.21	.21	.21	.22	.22	.22	.23	.23	.24	.24	81
10	.17	.18	.18	.19	.19	.19	.19	.20	.20	.21	.21	.21	.22	.23	.23	.23	.24	.24	.25	.25	.25	.26	.26	.27	**80**
11	.19	.19	.20	.20	.21	.21	.21	.22	.22	.23	.23	.24	.24	.25	.25	.26	.26	.27	.27	.28	.28	.28	.29	.30	79
12	.21	.21	.22	.22	.22	.23	.23	.24	.24	.25	.25	.26	.26	.27	.27	.28	.28	.29	.29	.30	.30	.31	.32	.32	78
13	.22	.23	.23	.24	.24	.25	.25	.26	.26	.27	.27	.28	.29	.29	.30	.30	.31	.31	.32	.32	.33	.34	.34	.35	77
14	.24	.25	.25	.26	.26	.27	.27	.27	.28	.29	.29	.30	.31	.32	.32	.33	.33	.34	.34	.35	.35	.36	.37	.38	76
15	.26	.26	.27	.28	.28	.28	.29	.29	.30	.31	.31	.32	.33	.34	.34	.35	.35	.36	.37	.37	.38	.39	.39	.40	75
16	.28	.28	.29	.29	.30	.30	.31	.31	.32	.33	.33	.34	.35	.36	.37	.37	.38	.38	.39	.40	.40	.41	.42	.43	74
17	.29	.30	.30	.31	.31	.32	.33	.33	.34	.34	.35	.36	.37	.38	.39	.39	.40	.41	.41	.42	.43	.44	.45	.45	73
18	.31	.31	.32	.33	.33	.33	.34	.35	.36	.36	.37	.38	.39	.40	.41	.42	.42	.43	.44	.44	.45	.46	.47	.48	72
19	.33	.33	.34	.35	.35	.36	.36	.37	.38	.38	.39	.40	.41	.42	.43	.44	.45	.45	.46	.47	.48	.49	.50	.51	71
20	.34	.35	.35	.36	.37	.37	.38	.39	.40	.40	.41	.42	.43	.45	.45	.46	.47	.48	.48	.49	.50	.51	.52	.53	**70**
21	.36	.36	.37	.38	.39	.39	.40	.41	.41	.42	.43	.44	.45	.47	.47	.48	.49	.50	.51	.52	.52	.54	.55	.56	69
22	.37	.38	.39	.40	.40	.41	.42	.42	.43	.44	.45	.46	.48	.49	.50	.50	.51	.52	.53	.54	.55	.56	.57	.58	68
23	.39	.40	.41	.42	.42	.43	.44	.44	.45	.46	.47	.48	.50	.51	.52	.53	.53	.54	.55	.56	.57	.58	.60	.61	67
24	.41	.41	.42	.43	.44	.45	.45	.46	.47	.48	.49	.50	.52	.53	.54	.55	.56	.57	.58	.59	.60	.61	.62	.63	66
25	.42	.43	.44	.45	.46	.46	.47	.48	.49	.50	.51	.52	.54	.55	.56	.57	.58	.59	.60	.61	.62	.63	.64	.66	65
26	.44	.45	.45	.47	.47	.48	.49	.50	.51	.52	.53	.54	.56	.57	.58	.59	.60	.61	.62	.63	.64	.65	.67	.68	64
27	.45	.46	.47	.48	.49	.50	.51	.51	.52	.54	.55	.56	.58	.59	.60	.61	.62	.63	.64	.65	.67	.68	.69	.71	63
28	.47	.48	.49	.50	.51	.51	.52	.53	.54	.55	.57	.58	.60	.61	.62	.63	.64	.65	.66	.68	.69	.70	.72	.73	62
29	.48	.49	.50	.52	.52	.53	.54	.55	.56	.57	.58	.60	.61	.63	.64	.65	.66	.67	.69	.70	.71	.72	.74	.75	61
30	.50	.51	.52	.53	.54	.55	.56	.57	.58	.59	.60	.62	.63	.65	.66	.67	.68	.69	.71	.72	.73	.75	.76	.78	**60**
31	.52	.52	.53	.55	.56	.56	.57	.58	.59	.61	.62	.64	.65	.67	.68	.69	.70	.72	.73	.74	.75	.77	.78	.80	59
32	.53	.54	.55	.56	.57	.58	.59	.60	.61	.63	.64	.65	.67	.69	.70	.71	.72	.74	.75	.76	.78	.79	.81	.82	58
33	.54	.55	56	.58	.59	.60	.61	.62	.63	.64	.66	.67	.69	.71	.72	.73	.74	.76	.77	.78	.80	.81	.83	.85	57
34	.56	.57	.58	.59	.60	.61	.62	.63	.65	.66	.67	.69	.71	.73	.74	.75	.76	.78	.79	.80	.82	.84	.85	.87	56
35	.57	.58	.59	.61	.62	.63	.64	.65	.66	.68	.69	.71	.73	.75	.76	.77	.78	.80	.81	.83	.84	.86	.87	.89	55
36	.59	.60	.61	.63	.63	.64	.65	.67	.68	.69	.71	.73	.75	.77	.78	.79	.80	.82	.83	.85	.86	.88	.90	.91	54
37	.60	.61	.62	.64	.65	.65	.67	.68	.70	.71	.73	.74	.76	.79	.80	.81	.82	.84	.85	.87	.88	.90	.92	.94	53
38	.62	.63	.64	.66	.66	.67	.69	.70	.71	.73	.74	.76	.78	.80	.82	.83	.84	.86	.87	.89	.90	.92	.94	.96	52
39	.63	.64	.65	.67	.68	.69	.70	.71	.73	.74	.76	.78	.80	.82	.83	.85	.86	.87	.89	.91	.92	.94	.96	.98	51
40	.64	.65	.66	.68	.69	.70	.72	.73	.74	.76	.77	.79	.82	.84	.85	.86	.88	.89	.91	.93	.94	.96	.98	1.00	**50**
41	.66	.67	.68	.70	.71	.72	.73	.74	.76	.77	.79	.81	.83	.86	.87	.88	.90	.91	.93	.94	.96	.98	1.00	1.02	49
42	.67	.68	.69	.71	.72	.73	.74	.76	.77	.79	.81	.83	.85	.87	.89	.90	.91	.93	.95	.96	.98	1.00	1.02	1.04	48
43	.68	.69	.71	.73	.74	.75	.76	.77	.79	.80	.82	.84	.86	.89	.90	.92	.93	.95	.96	.98	1.00	1.02	1.04	1.06	47
44	.69	.71	.72	.74	.75	.76	.77	.79	.80	.82	.84	.86	.89	.90	.92	.93	.95	.96	.98	1.00	1.02	1.04	1.06	1.08	46
45	.71	.72	.73	.75	.76	.77	.79	.80	.82	.83	.85	.87	.90	.92	.94	.95	.97	.98	1.00	1.02	1.04	1.06	1.08	1.10	45
46	.72	.73	.74	.77	.78	.79	.80	.82	.83	.85	.87	.89	.91	.94	.95	.97	.98	1.00	1.02	1.04	1.05	1.07	1.10	1.12	44
47	.73	.74	.76	.78	.79	.80	.81	.83	.84	.86	.88	.90	.93	.95	.97	.98	1.00	1.02	1.03	1.05	1.07	1.09	1.11	1.14	43
48	.74	.76	.77	.79	.80	.81	.83	.84	.86	.88	.90	.92	.94	.97	.98	1.00	1.02	1.03	1.05	1.07	1.09	1.11	1.13	1.16	42
49	.75	.77	.78	.80	.81	.83	.84	.86	.87	.89	.91	.93	.96	.99	1.00	1.02	1.03	1.05	1.07	1.09	1.11	1.13	1.15	1.17	41
50	.77	.78	.79	.82	.83	.84	.85	.87	.89	.90	.92	.95	.97	1.00	1.01	1.03	1.05	1.06	1.08	1.10	1.12	1.14	1.17	1.19	**40**
51	.78	.79	.80	.83	.84	.85	.87	.88	.90	.92	.94	.96	.99	1.01	1.03	1.05	1.06	1.08	1.10	1.12	1.14	1.16	1.18	1.21	39
52	.79	.80	.82	.84	.85	.86	.88	.89	.91	.93	.95	.97	1.00	1.03	1.04	1.06	1.08	1.10	1.11	1.13	1.15	1.18	1.20	1.23	38
53	.80	.81	.83	.85	.86	.87	.89	.91	.92	.94	.96	.99	1.01	1.04	1.06	1.07	1.09	1.11	1.13	1.15	1.17	1.19	1.22	1.24	37
54	.81	.82	.84	.86	.87	.89	.90	.92	.93	.95	.98	1.00	1.03	1.06	1.07	1.09	1.11	1.12	1.14	1.16	1.19	1.21	1.23	1.26	36
55	.82	.83	.85	.87	.88	.90	.91	.93	.95	.97	.99	1.01	1.04	1.0	1.08	1.10	1.12	1.14	1.16	1.18	1.20	1.22	1.25	1.27	35
56	.83	.84	.86	.88	.89	.91	.92	.94	.96	.98	1.00	1.02	1.05	1.08	1.10	1.12	1.13	1.15	1.17	1.19	1.22	1.24	1.26	1.29	34
57	.84	.85	.87	.89	.90	.92	.93	.95	.97	.99	1.01	1.04	1.06	1.09	1.11	1.13	1.15	1.17	1.19	1.21	1.23	1.25	1.28	1.31	33
58	.85	.86	.88	.90	.91	.93	.94	.96	.98	1.00	1.02	1.05	1.08	1.11	1.12	1.14	1.16	1.18	1.20	1.22	1.24	1.27	1.29	1.32	32
59	.86	.87	.89	.91	.92	.94	.95	.97	.99	1.01	1.03	1.06	1.09	1.12	1.14	1.15	1.17	1.19	1.21	1.23	1.26	1.28	1.31	1.33	31
60	.87	.88	.90	.92	.93	.95	.96	.98	1.00	1.02	1.04	1.07	1.10	1.13	1.15	1.17	1.18	1.20	1.22	1.25	1.27	1.29	1.32	1.35	**30**

TABLE XXVIII.—*Factors for reduction of transit observations*—Continued.

Azimuth factor A=sin ζ sec. δ. Star's declination ± δ. Inclination factor B=cos ζ sec. δ.

ζ	0°	10°	15°	20°	22°	24°	26°	28°	30°	32°	34°	36°	38°	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	50°	ζ
61	.87	.89	.91	.93	.94	.96	.97	.99	1.01	1.03	1.05	1.08	1.11	1.14	1.16	1.18	1.20	1.22	1.24	1.26	1.28	1.31	1.33	1.36	29
62	.88	.90	.91	.94	.95	.97	.98	1.00	1.02	1.04	1.06	1.09	1.12	1.15	1.17	1.19	1.21	1.23	1.25	1.27	1.29	1.32	1.35	1.37	28
63	.89	.91	.92	.95	.96	.98	.99	1.01	1.03	1.05	1.07	1.10	1.13	1.16	1.18	1.20	1.22	1.24	1.26	1.28	1.31	1.33	1.36	1.39	27
64	.90	.91	.93	.96	.97	.98	1.00	1.02	1.04	1.06	1.08	1.11	1.14	1.17	1.19	1.21	1.23	1.25	1.27	1.29	1.32	1.34	1.37	1.40	26
65	.91	.92	.94	.96	.98	.99	1.01	1.03	1.05	1.07	1.09	1.12	1.15	1.18	1.20	1.22	1.24	1.26	1.28	1.30	1.33	1.35	1.38	1.41	25
66	.91	.93	.95	.97	.99	1.00	1.02	1.04	1.06	1.08	1.10	1.13	1.16	1.19	1.21	1.23	1.25	1.27	1.29	1.32	1.34	1.37	1.39	1.42	24
67	.92	.94	.95	.98	.99	1.01	1.02	1.04	1.06	1.09	1.11	1.14	1.17	1.20	1.22	1.24	1.26	1.28	1.30	1.33	1.35	1.38	1.40	1.43	23
68	.93	.94	.96	.99	1.00	1.02	1.03	1.05	1.07	1.09	1.12	1.15	1.18	1.21	1.23	1.25	1.27	1.29	1.31	1.33	1.36	1.39	1.41	1.44	22
69	.93	.95	.97	.99	1.01	1.02	1.04	1.06	1.08	1.10	1.13	1.15	1.18	1.22	1.24	1.26	1.28	1.30	1.32	1.34	1.37	1.40	1.42	1.45	21
70	.94	.95	.97	1.00	1.01	1.03	1.05	1.06	1.09	1.11	1.13	1.16	1.19	1.23	1.25	1.26	1.28	1.31	1.33	1.35	1.38	1.40	1.43	1.46	**20**
71	.95	.96	.98	1.01	1.02	1.04	1.05	1.07	1.09	1.12	1.14	1.17	1.20	1.23	1.25	1.27	1.29	1.31	1.34	1.36	1.39	1.41	1.44	1.47	19
72	.95	.97	.98	1.01	1.03	1.04	1.06	1.08	1.10	1.12	1.15	1.17	1.21	1.24	1.26	1.28	1.30	1.32	1.34	1.37	1.39	1.42	1.45	1.48	18
73	.96	.97	.99	1.02	1.03	1.05	1.06	1.08	1.10	1.13	1.15	1.18	1.21	1.25	1.27	1.29	1.31	1.33	1.35	1.38	1.40	1.43	1.46	1.49	17
74	.96	.98	1.00	1.02	1.04	1.05	1.07	1.09	1.11	1.13	1.16	1.19	1.22	1.25	1.27	1.29	1.31	1.34	1.36	1.38	1.41	1.44	1.46	1.49	16
75	.97	.98	1.00	1.03	1.04	1.06	1.08	1.09	1.12	1.14	1.16	1.19	1.23	1.26	1.28	1.30	1.32	1.34	1.37	1.39	1.42	1.44	1.47	1.50	15
76	.97	.99	1.00	1.03	1.05	1.06	1.08	1.10	1.12	1.14	1.17	1.20	1.23	1.27	1.29	1.31	1.33	1.35	1.37	1.40	1.42	1.45	1.48	1.51	14
77	.97	.99	1.01	1.04	1.05	1.07	1.08	1.10	1.13	1.15	1.17	1.20	1.24	1.27	1.29	1.31	1.33	1.35	1.38	1.40	1.43	1.46	1.48	1.52	13
78	.98	.99	1.01	1.04	1.05	1.07	1.09	1.11	1.13	1.15	1.18	1.21	1.24	1.28	1.30	1.32	1.34	1.36	1.38	1.41	1.43	1.46	1.49	1.52	12
79	.98	1.00	1.02	1.04	1.06	1.08	1.09	1.11	1.13	1.16	1.18	1.21	1.25	1.28	1.30	1.32	1.34	1.36	1.39	1.41	1.44	1.47	1.50	1.53	11
80	.98	1.00	1.02	1.05	1.06	1.08	1.10	1.12	1.14	1.16	1.19	1.22	1.25	1.29	1.30	1.33	1.35	1.37	1.39	1.42	1.44	1.47	1.50	1.53	**10**
81	.99	1.00	1.02	1.05	1.07	1.08	1.10	1.12	1.14	1.17	1.19	1.22	1.25	1.29	1.31	1.33	1.35	1.37	1.40	1.42	1.45	1.48	1.51	1.54	9
82	.99	1.01	1.03	1.05	1.07	1.08	1.10	1.12	1.14	1.17	1.19	1.22	1.26	1.29	1.31	1.33	1.35	1.38	1.40	1.43	1.45	1.48	1.51	1.54	8
83	.99	1.01	1.03	1.06	1.07	1.09	1.10	1.12	1.15	1.17	1.20	1.23	1.26	1.30	1.32	1.34	1.36	1.38	1.40	1.43	1.46	1.48	1.51	1.54	7
84	.99	1.01	1.03	1.06	1.07	1.09	1.11	1.13	1.15	1.17	1.20	1.23	1.26	1.30	1.32	1.34	1.36	1.38	1.41	1.43	1.46	1.49	1.52	1.55	6
85	1.00	1.01	1.03	1.06	1.07	1.09	1.11	1.13	1.15	1.17	1.20	1.23	1.26	1.30	1.32	1.34	1.36	1.38	1.41	1.43	1.46	1.49	1.52	1.55	5
86	1.00	1.01	1.03	1.06	1.08	1.09	1.11	1.13	1.15	1.18	1.20	1.23	1.27	1.30	1.32	1.34	1.36	1.39	1.41	1.44	1.46	1.49	1.52	1.55	4
87	1.00	1.01	1.03	1.06	1.08	1.09	1.11	1.13	1.15	1.18	1.20	1.23	1.27	1.30	1.32	1.34	1.37	1.39	1.41	1.44	1.46	1.49	1.52	1.55	3
88	1.00	1.01	1.03	1.06	1.08	1.09	1.11	1.13	1.15	1.18	1.20	1.23	1.27	1.30	1.32	1.34	1.37	1.39	1.41	1.44	1.46	1.49	1.52	1.55	2
89	1.00	1.02	1.04	1.06	1.08	1.09	1.11	1.13	1.15	1.18	1.21	1.24	1.27	1.31	1.32	1.35	1.37	1.39	1.41	1.44	1.47	1.49	1.52	1.56	1
90	1.00	1.02	1.04	1.06	1.08	1.09	1.11	1.13	1.15	1.18	1.21	1.24	1.27	1.31	1.32	1.35	1.37	1.39	1.41	1.44	1.47	1.49	1.52	1.56	**0**

TABLE XXVIII.—*Factors for reduction of transit observations*—Continued.

Azimuth factor A = sin ζ sec. δ. Star's declination ± δ. Inclination factor B = cos ζ sec. δ.

ζ	51°	52°	53°	54°	55°	56°	57°	58°	59°	60°	60½°	61°	61½°	62°	62½°	63°	63½°	64°	64½°	65°	65½	66°	66½°	67°	ζ
1°	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.04	.04	.04	.04	.04	.04	.04	.04	.04	.04	.04	.04	.04	.04	89°
2	.06	.06	.06	.06	.06	.06	.06	.07	.07	.07	.07	.07	.07	.07	.08	.08	.08	.08	.08	.08	.08	.09	.09	.09	88
3	.08	.08	.09	.09	.09	.08	.10	.10	.10	.10	.11	.11	.11	.11	.11	.12	.12	.12	.12	.12	.13	.13	.13	.13	87
4	.11	.11	.12	.12	.12	.12	.13	.13	.14	.14	.14	.14	.15	.15	.15	.15	.16	.16	.16	.17	.17	.17	.18	.18	86
5	.14	.14	.14	.15	.15	.16	.16	.16	.17	.17	.18	.18	.18	.19	.19	.19	.19	.20	.20	.21	.21	.21	.22	.22	85
6	.17	.17	.17	.18	.18	.19	.19	.20	.20	.21	.21	.22	.22	.22	.23	.23	.23	.24	.24	.25	.25	.26	.26	.27	84
7	.19	.20	.20	.21	.21	.22	.22	.23	.24	.24	.25	.25	.26	.26	.26	.27	.27	.28	.28	.29	.29	.30	.31	.31	83
8	.22	.23	.23	.24	.24	.25	.26	.26	.27	.28	.28	.29	.29	.30	.30	.31	.31	.32	.32	.33	.34	.34	.35	.36	82
9	.25	.25	.26	.26	.27	.28	.29	.29	.30	.31	.32	.32	.33	.33	.34	.35	.35	.36	.36	.37	.38	.39	.39	.40	81
10	.28	.28	.29	.30	.30	.31	.32	.33	.34	.35	.35	.36	.36	.37	.38	.38	.39	.40	.40	.41	.42	.43	.43	.44	**80**
11	.30	.31	.32	.32	.33	.34	.35	.36	.37	.38	.39	.39	.40	.41	.41	.42	.43	.44	.44	.45	.46	.47	.48	.49	77
12	.33	.34	.35	.35	.36	.37	.38	.39	.40	.42	.42	.43	.44	.44	.45	.46	.47	.47	.48	.49	.50	.51	.52	.53	78
13	.36	.36	.37	.38	.39	.40	.41	.42	.44	.45	.46	.46	.47	.48	.49	.50	.50	.51	.52	.53	.54	.55	.56	.58	77
14	.38	.39	.40	.41	.42	.43	.44	.46	.47	.48	.49	.50	.51	.52	.52	.53	.54	.55	.56	.57	.58	.59	.61	.62	76
15	.41	.42	.43	.44	.45	.46	.48	.49	.50	.52	.53	.53	.54	.55	.56	.57	.58	.59	.60	.61	.62	.64	.65	.66	75
16	.44	.45	.46	.47	.48	.49	.51	.52	.54	.55	.56	.57	.58	.59	.60	.61	.62	.63	.64	.65	.66	.68	.69	.71	74
17	.46	.47	.49	.50	.51	.52	.54	.55	.57	.58	.59	.60	.61	.62	.63	.64	.66	.67	.68	.69	.70	.72	.73	.75	73
18	.49	.50	.51	.53	.54	.55	.57	.58	.60	.62	.63	.64	.65	.66	.67	.68	.69	.70	.72	.73	.74	.76	.77	.79	72
19	.52	.53	.54	.55	.57	.58	.60	.61	.63	.65	.66	.67	.68	.69	.70	.72	.73	.74	.76	.77	.78	.80	.82	.83	71
20	.54	.56	.57	.58	.60	.61	.63	.64	.66	.68	.69	.70	.72	.73	.74	.75	.77	.79	.79	.81	.83	.84	.86	.88	**70**
21	.57	.58	.59	.61	.62	.64	.66	.68	.70	.72	.73	.74	.75	.76	.78	.79	.80	.82	.83	.85	.86	.88	.90	.92	69
22	.60	.61	.62	.64	.65	.67	.69	.71	.73	.75	.76	.77	.78	.80	.81	.82	.84	.85	.87	.89	.90	.92	.94	.96	68
23	.62	.63	.65	.66	.68	.70	.72	.74	.76	.78	.79	.81	.82	.83	.85	.86	.88	.89	.91	.92	.94	.96	.98	1.00	67
24	.65	.66	.68	.69	.71	.73	.75	.77	.79	.81	.83	.84	.85	.87	.88	.90	.91	.93	.94	.96	.98	1.00	1.02	1.04	66
25	.67	.69	.70	.72	.74	.76	.78	.80	.82	.85	.86	.87	.89	.90	.92	.93	.95	.96	.98	1.00	1.02	1.04	1.06	1.08	65
26	.70	.71	.73	.75	.76	.78	.80	.83	.85	.88	.89	.90	.92	.93	.95	.97	.98	1.00	1.02	1.04	1.06	1.08	1.10	1.12	64
27	.72	.74	.75	.77	.79	.81	.83	.86	.88	.91	.92	.94	.95	.97	.98	1.00	1.02	1.04	1.05	1.07	1.09	1.12	1.14	1.16	63
28	.75	.76	.78	.80	.82	.84	.86	.89	.91	.94	.95	.97	.98	1.00	1.02	1.03	1.05	1.07	1.09	1.11	1.13	1.15	1.18	1.20	62
29	.77	.79	.81	.82	.84	.87	.89	.91	.94	.97	.98	1.00	1.02	1.03	1.05	1.07	1.09	1.11	1.13	1.15	1.17	1.19	1.22	1.24	61
30	.79	.81	.83	.85	.87	.89	.92	.94	.97	1.00	1.01	1.03	1.05	1.07	1.08	1.10	1.12	1.14	1.16	1.18	1.21	1.23	1.25	1.28	**60**
31	.82	.84	.86	.88	.90	.92	.95	.97	1.00	1.03	1.05	1.06	1.08	1.10	1.11	1.13	1.15	1.17	1.20	1.22	1.24	1.27	1.29	1.32	59
32	.84	.86	.88	.90	.92	.95	.97	1.00	1.03	1.06	1.08	1.09	1.11	1.13	1.15	1.17	1.19	1.21	1.23	1.25	1.28	1.30	1.33	1.36	58
33	.87	.88	.91	.93	.95	.97	1.00	1.03	1.06	1.09	1.11	1.12	1.14	1.16	1.18	1.20	1.22	1.24	1.26	1.29	1.31	1.34	1.37	1.39	57
34	.89	.91	.93	.95	.97	1.00	1.03	1.05	1.09	1.12	1.14	1.15	1.17	1.19	1.21	1.23	1.25	1.27	1.30	1.32	1.35	1.37	1.40	1.43	56
35	.91	.93	.95	.98	1.00	1.03	1.05	1.08	1.11	1.15	1.16	1.18	1.20	1.22	1.24	1.26	1.29	1.31	1.33	1.36	1.38	1.41	1.44	1.47	55
36	.93	.95	.98	1.00	1.03	1.05	1.08	1.11	1.14	1.18	1.19	1.21	1.23	1.25	1.27	1.30	1.32	1.34	1.37	1.39	1.42	1.45	1.47	1.51	54
37	.96	.98	1.00	1.02	1.05	1.08	1.10	1.14	1.17	1.20	1.22	1.24	1.26	1.28	1.30	1.33	1.35	1.37	1.40	1.42	1.45	1.48	1.51	1.54	53
38	.98	1.00	1.02	1.05	1.07	1.10	1.13	1.16	1.20	1.23	1.25	1.27	1.29	1.31	1.33	1.36	1.38	1.40	1.43	1.46	1.48	1.51	1.54	1.58	52
39	1.00	1.02	1.05	1.07	1.10	1.12	1.15	1.19	1.22	1.26	1.28	1.30	1.32	1.34	1.36	1.39	1.41	1.43	1.46	1.49	1.52	1.55	1.58	1.61	51
40	1.02	1.04	1.07	1.09	1.12	1.15	1.18	1.21	1.25	1.29	1.31	1.33	1.35	1.37	1.39	1.42	1.44	1.47	1.49	1.52	1.55	1.58	1.61	1.65	**50**
41	1.04	1.07	1.09	1.12	1.14	1.17	1.20	1.24	1.27	1.31	1.33	1.35	1.37	1.40	1.42	1.45	1.47	1.50	1.53	1:55	1.58	1.61	1.64	1.68	49
42	1.06	1.09	1.11	1.14	1.17	1.20	1.23	1.26	1.30	1.34	1.36	1.38	1.40	1.42	1.45	1.47	1.50	1.53	1.55	1.58	1.61	1.64	1.68	1.71	48
43	1.08	1.11	1.13	1.16	1.19	1.22	1.25	1.29	1.32	1.36	1.39	1.41	1.43	1.45	1.48	1.50	1.53	1.56	1.58	1.61	1.64	1.68	1.71	1.75	47
44	1.10	1.13	1.15	1.18	1.21	1.24	1.28	1.31	1.35	1.39	1.41	1.43	1.46	1.48	1.50	1.53	1.56	1.58	1.61	1.64	1.67	1.71	1.74	1.78	46
45	1.12	1.15	1.17	1.20	1.23	1.26	1.30	1.33	1.37	1.41	1.44	1.46	1.48	1.51	1.53	1.56	1.58	1.61	1.64	1.67	1.70	1.74	1.77	1.81	45

TABLE XXVIII.—*Factors for reduction of transit observations*—Continued.

Azimuth factor A = sin sec. δ. Star's declination ± δ. Inclination factor B = cos ζ sec. δ.

ζ	51°	52°	53°	54°	55°	56°	57°	58°	59°	60°	60½°	61°	61½°	62°	62½°	63°	63½°	64°	64½°	65°	65½°	66°	66½°	67°	ζ
46°	1.14	1.17	1.19	1.22	1.25	1.29	1.32	1.36	1.40	1.44	1.46	1.48	1.51	1.53	1.56	1.58	1.61	1.64	1.67	1.70	1.74	1.77	1.80	1.84	44°
47	1.16	1.19	1.21	1.24	1.27	1.31	1.34	1.38	1.42	1.46	1.49	1.51	1.53	1.56	1.58	1.61	1.64	1.67	1.70	1.73	1.76	1.80	1.83	1.87	43
48	1.18	1.21	1.23	1.26	1.30	1.33	1.36	1.40	1.44	1.48	1.50	1.53	1.55	1.58	1.60	1.63	1.66	1.69	1.72	1.75	1.79	1.82	1.86	1.90	42
49	1.20	1.23	1.25	1.28	1.32	1.35	1.39	1.42	1.47	1.51	1.53	1.56	1.58	1.61	1.63	1.66	1.69	1.72	1.75	1.79	1.82	1.86	1.89	1.93	41
50	1.22	1.24	1.27	1.30	1.34	1.37	1.41	1.44	1.49	1.53	1.56	1.58	1.60	1.63	1.66	1.69	1.72	1.75	1.78	1.81	1.85	1.88	1.92	1.96	40
51	1.23	1.26	1.29	1.32	1.35	1.39	1.43	1.47	1.51	1.55	1.58	1.60	1.63	1.66	1.68	1.71	1.74	1.77	1.80	1.84	1.87	1.91	1.95	1.99	39
52	1.25	1.28	1.31	1.34	1.37	1.41	1.45	1.49	1.53	1.58	1.60	1.63	1.65	1.68	1.71	1.74	1.77	1.80	1.83	1.86	1.90	1.94	1.98	2.02	38
53	1.27	1.30	1.33	1.36	1.39	1.43	1.47	1.51	1.55	1.60	1.62	1.65	1.67	1.70	1.73	1.76	1.79	1.82	1.85	1.89	1.93	1.96	2.00	2.04	37
54	1.29	1.31	1.34	1.38	1.41	1.45	1.49	1.53	1.57	1.62	1.64	1.67	1.69	1.72	1.75	1.78	1.81	1.85	1.88	1.91	1.95	1.99	2.03	2.07	36
55	1.30	1.33	1.36	1.39	1.43	1.46	1.50	1.55	1.59	1.64	1.66	1.69	1.72	1.74	1.77	1.80	1.84	1.87	1.90	1.94	1.98	2.01	2.05	2.10	35
56	1.32	1.35	1.38	1.41	1.45	1.48	1.52	1.56	1.61	1.66	1.68	1.71	1.74	1.77	1.80	1.83	1.86	1.89	1.93	1.96	2.00	2.04	2.08	2.12	34
57	1.33	1.36	1.39	1.43	1.46	1.50	1.54	1.58	1.63	1.68	1.70	1.73	1.76	1.79	1.82	1.85	1.88	1.91	1.95	1.98	2.02	2.06	2.10	2.15	33
58	1.35	1.38	1.41	1.44	1.48	1.52	1.56	1.60	1.65	1.70	1.72	1.75	1.78	1.81	1.84	1.87	1.90	1.93	1.97	2.01	2.05	2.08	2.13	2.17	32
59	1.36	1.39	1.42	1.46	1.49	1.53	1.57	1.62	1.66	1.71	1.74	1.77	1.80	1.83	1.86	1.89	1.92	1.95	1.99	2.03	2.07	2.11	2.15	2.19	31
60	1.38	1.41	1.44	1.47	1.51	1.55	1.59	1.63	1.68	1.73	1.76	1.79	1.81	1.84	1.88	1.91	1.94	1.97	2.01	2.05	2.09	2.13	2.17	2.22	**30**
61	1.39	1.42	1.45	1.49	1.53	1.56	1.61	1.65	1.70	1.75	1.78	1.80	1.83	1.86	1.89	1.93	1.96	2.00	2.03	2.07	2.11	2.15	2.19	2.24	29
62	1.40	1.43	1.47	1.50	1.54	1.58	1.62	1.67	1.71	1.77	1.79	1.82	1.85	1.88	1.91	1.94	1.98	2.01	2.05	2.09	2.13	2.17	2.21	2.26	28
63	1.42	1.45	1.49	1.52	1.55	1.59	1.64	1.68	1.73	1.78	1.81	1.84	1.87	1.90	1.93	1.96	2.00	2.03	2.07	2.11	2.15	2.19	2.23	2.28	27
64	1.43	1.46	1.49	1.53	1.57	1.61	1.65	1.70	1.75	1.80	1.83	1.85	1.88	1.91	1.95	1.98	2.02	2.05	2.09	2.13	2.17	2.21	2.25	2.30	26
65	1.44	1.47	1.51	1.54	1.58	1.62	1.66	1.71	1.76	1.81	1.84	1.87	1.90	1.93	1.96	2.00	2.03	2.07	2.11	2.14	2.19	2.23	2.27	2.32	25
66	1.45	1.48	1.52	1.55	1.59	1.63	1.68	1.72	1.77	1.83	1.85	1.88	1.91	1.95	1.98	2.01	2.05	2.08	2.12	2.16	2.20	2.25	2.29	2.34	24
67	1.46	1.50	1.53	1.57	1.60	1.65	1.69	1.74	1.79	1.84	1.87	1.90	1.93	1.96	1.99	2.03	2.06	2.10	2.14	2.18	2.22	2.26	2.31	2.36	23
68	1.47	1.51	1.54	1.58	1.62	1.66	1.70	1.75	1.80	1.85	1.88	1.91	1.94	1.97	2.01	2.04	2.08	2.11	2.15	2.19	2.24	2.28	2.32	2.37	22
69	1.48	1.52	1.55	1.59	1.63	1.67	1.71	1.76	1.81	1.87	1.90	1.93	1.96	1.99	2.02	2.06	2.09	2.13	2.17	2.21	2.25	2.30	2.34	2.39	21
70	1.49	1.53	1.56	1.60	1.64	1.68	1.73	1.77	1.82	1.88	1.91	1.94	1.97	2.00	2.03	2.07	2.11	2.14	2.18	2.22	2.27	2.31	2.36	2.40	**20**
71	1.50	1.54	1.57	1.61	1.65	1.69	1.74	1.78	1.84	1.89	1.92	1.95	1.98	2.01	2.05	2.08	2.12	2.16	2.20	2.24	2.28	2.32	2.37	2.42	19
72	1.51	1.54	1.58	1.62	1.66	1.70	1.75	1.80	1.85	1.90	1.93	1.96	1.99	2.03	2.06	2.09	2.13	2.17	2.21	2.25	2.29	2.34	2.38	2.43	18
73	1.52	1.55	1.59	1.63	1.67	1.71	1.76	1.80	1.86	1.91	1.94	1.97	2.00	2.04	2.07	2.11	2.14	2.18	2.22	2.26	2.31	2.35	2.40	2.45	17
74	1.53	1.56	1.60	1.63	1.68	1.72	1.76	1.81	1.87	1.92	1.95	1.98	2.01	2.05	2.08	2.12	2.15	2.19	2.23	2.27	2.32	2.36	2.41	2.46	16
75	1.53	1.57	1.60	1.64	1.68	1.73	1.77	1.82	1.88	1.93	1.96	1.99	2.02	2.06	2.09	2.13	2.16	2.20	2.24	2.29	2.33	2.37	2.42	2.47	15
76	1.54	1.58	1.61	1.65	1.69	1.73	1.78	1.83	1.88	1.94	1.97	2.00	2.03	2.07	2.10	2.14	2.17	2.21	2.25	2.30	2.34	2.39	2.43	2.48	14
77	1.55	1.58	1.62	1.66	1.70	1.74	1.79	1.84	1.89	1.95	1.98	2.01	2.04	2.07	2.11	2.15	2.18	2.22	2.26	2.31	2.35	2.40	2.44	2.49	13
78	1.55	1.59	1.62	1.66	1.70	1.75	1.80	1.85	1.90	1.96	1.99	2.02	2.05	2.08	2.12	2.15	2.19	2.23	2.27	2.31	2.36	2.40	2.45	2.50	12
79	1.56	1.59	1.63	1.67	1.71	1.76	1.80	1.85	1.91	1.96	1.99	2.02	2.06	2.09	2.13	2.16	2.20	2.24	2.28	2.32	2.37	2.41	2.46	2.51	11
80	1.56	1.60	1.64	1.67	1.72	1.76	1.81	1.86	1.91	1.97	2.00	2.03	2.06	2.10	2.13	2.17	2.21	2.25	2.29	2.33	2.38	2.42	2.47	2.52	**10**
81	1.57	1.60	1.64	1.68	1.72	1.77	1.81	1.86	1.92	1.98	2.01	2.04	2.07	2.10	2.14	2.18	2.21	2.25	2.29	2.34	2.38	2.43	2.48	2.53	9
82	1.57	1.61	1.64	1.68	1.73	1.77	1.82	1.87	1.92	1.98	2.01	1.04	2.08	2.11	2.15	2.18	2.22	2.26	2.30	2.34	2.39	2.43	2.48	2.53	8
83	1.58	1.61	1.65	1.69	1.73	1.77	1.82	1.87	1.93	1.99	2.02	2.05	2.08	2.12	2.15	2.19	2.22	2.26	2.31	2.35	2.39	2.44	2.49	2.54	7
84	1.58	1.62	1.65	1.69	1.73	1.78	1.83	1.88	1.93	1.99	2.02	2.05	2.08	2.12	2.15	2.19	2.23	2.27	2.31	2.35	2.40	2.45	2.49	2.55	6
85	1.58	1.62	1.65	1.69	1.74	1.78	1.83	1.88	1.93	1.99	2.02	2.05	2.09	2.12	2.16	2.19	2.23	2.27	2.31	2.36	2.40	2.45	2.50	2.55	5
86	1.59	1.62	1.66	1.70	1.74	1.78	1.83	1.88	1.94	2.00	2.03	2.06	2.09	2.13	2.16	2.20	2.24	2.28	2.32	2.36	2.41	2.45	2.50	2.55	4
87	1.59	1.62	1.66	1.70	1.74	1.79	1.83	1.88	1.94	2.00	2.03	2.06	2.09	2.13	2.16	2.20	2.24	2.28	2.32	2.36	2.41	2.46	2.50	2.56	3
88	1.59	1.62	1.66	1.70	1.74	1.79	1.83	1.89	1.94	2.00	2.03	2.06	2.09	2.13	2.16	2.20	2.24	2.28	2.32	2.36	2.41	2.46	2.51	2.56	2
89	1.59	1.62	1.66	1.70	1.74	1.79	1.84	1.89	1.94	2.00	2.03	2.06	2.10	2.13	2.17	2.20	2.24	2.28	2.32	2.37	2.41	2.46	2.51	2.56	1
90	1.59	1.62	1.66	1.70	1.74	1.79	1.84	1.89	1.94	2.00	2.03	2.06	2.10	2.13	2.17	2.20	2.24	2.28	2.32	2.27	2.41	2.46	2.51	2.56	**0**

TABLE XXVIII.—*Factors for reduction of transit observations*—Continued.

Azimuth factor A = sin ζ sec. δ. Star's declination ± δ. Inclination factor B = cos ζ sec. δ.

ζ	67½°	68°	68½°	69°	69½°	70°	70¼°	70½°	70¾°	71°	71¼°	71½°	71¾°	72°	72¼°	72½°	72¾°	73°	73¼°	73½°	73¾°	74°	74¼°	ζ
1°	.05	.05	.05	.05	.05	.05	.05	.05	.05	.05	.05	.05	.05	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06	89°
2	.09	.09	.10	.10	.10	.10	.10	.10	.11	.11	.11	.11	.11	.11	.11	.12	.12	.12	.12	.12	.12	.13	.13	88
3	.14	.14	.14	.15	.15	.15	.15	.16	.16	.16	.16	.16	.17	.17	.17	.17	.18	.18	.18	.18	.19	.19	.19	87
4	.18	.19	.19	.20	.20	.20	.21	.21	.21	.21	.22	.22	.22	.23	.23	.23	.23	.24	.24	.24	.25	.25	.26	86
5	.23	.23	.24	.24	.25	.25	.26	.26	.26	.27	.27	.27	.28	.28	.29	.29	.29	.30	.30	.31	.31	.32	.32	85
6	.27	.28	.28	.29	.30	.31	.31	.31	.32	.32	.33	.33	.33	.34	.34	.35	.35	.36	.36	.37	.37	.38	.39	84
7	.32	.33	.33	.34	.35	.36	.36	.37	.37	.37	.38	.38	.39	.39	.40	.41	.41	.42	.42	.43	.44	.44	.45	83
8	.36	.37	.38	.39	.40	.41	.41	.42	.42	.43	.43	.44	.44	.45	.46	.46	.47	.48	.48	.49	.50	.50	.51	82
9	.41	.42	.43	.44	.45	.46	.46	.47	.47	.48	.49	.49	.50	.51	.51	.52	.53	.53	.54	.55	.56	.57	.58	81
10	.45	.46	.47	.49	.50	.51	.51	.52	.53	.53	.54	.55	.55	.56	.57	.58	.59	.60	.60	.61	.62	.63	.64	**80**
11	.50	.51	.52	.53	.54	.56	.56	.57	.58	.59	.59	.60	.61	.62	.63	.63	.64	.65	.66	.67	.68	.69	.70	79
12	.54	.56	.57	.58	.59	.61	.62	.62	.63	.64	.65	.63	.66	.67	.68	.69	.70	.71	.72	.73	.74	.75	.77	78
13	.59	.60	.61	.63	.64	.66	.67	.67	.68	.69	.70	.71	.72	.73	.74	.75	.76	.77	.78	.79	.80	.82	.83	77
14	.63	.65	.66	.68	.69	.71	.72	.72	.73	.74	.75	.76	.77	.78	.79	.80	.82	.83	.84	.85	.87	.88	.89	76
15	.68	.69	.71	.72	.74	.76	.77	.78	.78	.79	.80	.81	.83	.84	.85	.86	.87	.89	.90	.91	.93	.94	.95	75
16	.72	.74	.75	.77	.79	.81	.82	.83	.84	.85	.86	.87	.88	.89	.91	.92	.93	.94	.96	.97	.99	1.00	1.02	74
17	.76	.78	.80	.81	.83	.85	.86	.88	.89	.90	.91	.92	.93	.95	.96	.97	.99	1.00	1.01	1.03	1.05	1.06	1.08	73
18	.81	.83	.84	.86	.88	.90	.91	.93	.94	.95	.96	.97	.99	1.00	1.01	1.03	1.04	1.06	1.07	1.09	1.10	1.12	1.14	72
19	.85	.87	.89	.91	.93	.95	.96	.98	.99	1.00	1.01	1.03	1.04	1.05	1.07	1.08	1.10	1.11	1.13	1.15	1.16	1.18	1.20	71
20	.89	.91	.93	.95	.98	1.00	1.01	1.02	1.04	1.05	1.06	1.08	1.09	1.11	1.12	1.14	1.15	1.17	1.19	1.20	1.22	1.24	1.26	**70**
21	.94	.96	.98	1.00	1.02	1.05	1.06	1.07	1.09	1.10	1.11	1.13	1.14	1.16	1.17	1.19	1.21	1.22	1.24	1.26	1.28	1.30	1.32	69
22	.98	1.00	1.02	1.05	1.07	1.09	1.11	1.12	1.14	1.15	1.17	1.18	1.20	1.21	1.23	1.25	1.26	1.28	1.30	1.32	1.34	1.36	1.38	68
23	1.02	1.04	1.07	1.09	1.12	1.14	1.16	1.17	1.19	1.20	1.21	1.23	1.25	1.26	1.28	1.30	1.32	1.34	1.36	1.38	1.40	1.42	1.44	67
24	1.06	1.09	1.11	1.14	1.16	1.19	1.20	1.22	1.23	1.25	1.27	1.28	1.30	1.32	1.33	1.35	1.37	1.39	1.41	1.43	1.45	1.48	1.50	66
25	1.10	1.13	1.15	1.18	1.21	1.24	1.25	1.27	1.28	1.30	1.31	1.33	1.35	1.37	1.39	1.41	1.42	1.45	1.47	1.49	1.51	1.53	1.56	65
26	1.15	1.17	1.20	1.22	1.25	1.28	1.30	1.31	1.33	1.35	1.36	1.38	1.40	1.42	1.44	1.46	1.48	1.50	1.52	1.54	1.57	1.59	1.61	64
27	1.19	1.21	1.24	1.27	1.30	1.33	1.34	1.36	1.38	1.39	1.41	1.43	1.45	1.47	1.49	1.51	1.53	1.55	1.58	1.60	1.62	1.65	1.67	63
28	1.23	1.25	1.28	1.31	1.34	1.37	1.39	1.41	1.42	1.44	1.46	1.48	1.50	1.52	1.54	1.56	1.58	1.60	1.63	1.65	1.68	1.70	1.73	62
29	1.27	1.29	1.32	1.35	1.38	1.42	1.43	1.45	1.47	1.49	1.51	1.53	1.55	1.57	1.59	1.61	1.63	1.66	1.68	1.71	1.73	1.76	1.79	61
30	1.31	1.33	1.36	1.39	1.43	1.46	1.48	1.50	1.52	1.54	1.56	1.58	1.60	1.62	1.64	1.66	1.69	1.71	1.73	1.76	1.79	1.81	1.84	**60**
31	1.35	1.38	1.40	1.44	1.47	1.51	1.52	1.54	1.56	1.58	1.60	1.62	1.64	1.67	1.69	1.71	1.74	1.76	1.79	1.81	1.84	1.87	1.90	59
22	1.39	1.42	1.45	1.48	1.51	1.55	1.57	1.59	1.61	1.63	1.65	1.67	1.69	1.71	1.74	1.76	1.79	1.81	1.84	1.87	1.89	1.92	1.95	58
33	1.42	1.45	1.49	1.52	1.55	1.59	1.61	1.63	1.65	1.67	1.69	1.72	1.74	1.76	1.79	1.81	1.84	1.86	1.89	1.92	1.95	1.98	2.01	57
34	1.46	1.49	1.53	1.56	1.60	1.63	1.65	1.68	1.70	1.72	1.74	1.76	1.79	1.81	1.83	1.86	1.89	1.91	1.94	1.97	2.00	2.03	2.06	56
35	1.50	1.53	1.56	1.60	1.64	1.68	1.70	1.72	1.74	1.76	1.78	1.81	1.83	1.86	1.88	1.91	1.93	1.96	1.99	2.02	2.05	2.08	2.11	55
36	1.54	1.57	1.60	1.64	1.68	1.72	1.74	1.76	1.78	1.80	1.83	1.85	1.88	1.90	1.93	1.95	1.98	2.01	2.04	2.07	2.10	2.13	2.16	54
37	1.57	1.61	1.64	1.68	1.72	1.76	1.78	1.80	1.83	1.85	1.87	1 90	1.92	1.95	1.97	2.00	2.03	2.06	2.09	2.12	2.15	2.18	2.22	53
38	1.61	1.64	1.68	1.72	1.76	1.80	1.82	1.84	1.87	1.89	1.91	1.94	1.97	1.99	2.02	2.05	2.08	2.11	2.14	2.17	2.20	2.23	2.27	52
39	1.65	1.68	1.72	1.75	1.80	1.84	1.86	1.88	1.91	1.93	1.96	1.98	2.01	2.04	2.06	2.09	2.12	2.15	2.18	2.22	2.25	2.28	2.32	51
40	1.68	1.72	1.75	1.79	1.84	1.88	1.90	1.93	1.95	1.97	2.00	2.03	2.05	2.08	2.11	2.14	2.17	2.20	2.23	2.26	2.30	2.33	2.37	**50**
41	1.71	1.75	1.79	1.83	1.87	1.92	1.94	1.96	1.99	2.01	2.04	2.07	2.09	2.12	2.15	2.18	2.21	2.24	2.28	2.31	2.34	2.38	2.42	49
42	1.75	1.79	1.83	1.87	1.91	1.96	1.98	2.00	2.03	2.05	2.08	2.11	2.14	2.16	2.19	2.22	2.26	2.29	2.32	2.36	2.39	2.43	2.46	48
43	1.78	1.82	1.86	1.90	1.95	1.99	2.02	2.04	2.07	2.09	2.12	2.15	2.18	2.21	2.24	2.27	2.30	2.33	2.37	2.40	2.44	2.47	2.51	47
44	1.82	1.85	1.90	1.94	1 98	2.03	2.06	2.08	2.11	2.13	2.16	2.19	2.22	2.25	2.28	2.31	2.34	2.38	2.41	2.45	2.48	2.52	2.56	46
45	1.85	1.89	1.93	1.97	2.02	2.07	2.09	2.12	2.14	2.17	2.20	2.23	2.26	2.29	2.32	2.35	2.38	2.42	2.45	2.49	2.53	2.56	2.60	45

TABLE XXVIII.—*Factors for reduction of transit observations*—Continued.

Azimuth factor A = sin ζ sec. δ. Star's declination ± δ. Inclination factor B=cos ζ sec. δ.

ζ	67½°	68°	68½°	69°	69½°	70°	70¼°	70½°	70¾°	71°	71¼°	71½°	71¾°	72°	72¼°	72½°	72¾°	73°	73¼°	73½°	73¾°	74°	74¼°	ζ
46°	1.88	1.92	1.96	2.01	2.05	2.10	2.13	2.15	2.18	2.21	2.24	2.27	2.30	2.33	2.36	2.39	2.42	2.46	2.49	2.53	2.57	2.61	2.65	44°
47	1.91	1.95	2.00	2.04	2.09	2.14	2.16	2.19	2.22	2.25	2.27	2.30	3.33	2.37	2.40	2.43	2.47	2.50	2.54	2.57	2.61	2.65	2.69	43
48	1.94	2.98	2.02	2.07	2.12	2.17	2.19	2.22	2.25	2.28	2.31	2.34	2.37	2.40	2.44	2.47	2.51	2.54	2.58	2.62	2.66	2.70	2.74	42
49	1.97	2.01	2.06	2.11	2.16	2.21	2.23	2.26	2.29	2.32	2.35	2.38	2.41	2.44	2.48	2.51	2.55	2.58	2.62	2.66	2.70	2.74	2.78	41
50	2.00	2.04	2.09	2.14	2.19	2.24	2.27	2.29	2.32	2.35	2.38	2.41	2.45	2.48	2.51	2.55	2.58	2.62	2.66	2.70	2.74	2.78	2.82	**40**
51	2.03	2.07	2.12	2.17	2.22	2.27	2.30	2.33	2.36	2.39	2.42	2.45	2.48	2.51	2.55	2.58	2.62	2.66	2.70	2.74	2.78	2.82	2.86	39
52	2.06	2.10	2.15	2.20	2.25	2.30	2.33	2.36	2.39	2.42	2.45	2.48	2.52	2.55	2.58	2.62	2.66	2.69	2.73	2.77	2.82	2.86	2.90	38
53	2.09	2.13	2.18	2.23	2.28	2.33	2.36	2.39	2.42	2.45	2.48	2.52	2.55	2.58	2.62	2.66	2.69	2.73	2.77	2.81	2.85	2.90	2.94	37
54	2.11	2.16	2.21	2.26	2.31	2.37	2.39	2.42	2.45	2.48	2.52	2.55	2.58	2.62	2.65	2.69	2.73	2.77	2.81	2.85	2.89	2.94	2.98	36
55	2.14	2.19	2.23	2.29	2.34	2.40	2.42	2.45	2.48	2.52	2.55	2.58	2.62	2.65	2.69	2.72	2.76	2.80	2.84	2.88	2.93	2.97	3.02	35
56	2.17	2.21	2.26	2.31	2.37	2.42	2.45	2.48	2.51	2.55	2.58	2.61	2.65	2.68	2.72	2.76	2.80	2.84	2.88	2.92	2.96	3.01	3.05	34
57	2.19	2.24	2.29	2.34	2.39	2.45	2.48	2.51	2.54	2.58	2.61	2.64	2.68	2.71	2.75	2.79	2.83	2.87	2.91	2.95	3.00	3.04	3.09	33
58	2.22	2.26	2.3.	2.37	2.42	2.48	2.51	2.54	2.57	2.61	2.64	2.67	2.71	2.74	2.78	2.82	2.86	2.90	2.94	2.99	3.03	3.08	3.12	32
59	2.24	2.29	2.34	2.39	2.45	2.51	2.54	2.57	2.60	2.63	2.67	2.70	2.74	2.77	2.81	2.85	2.89	2.93	2.97	3.02	3.06	3.11	3.16	31
50	2.26	2.31	2.36	2.42	2.47	2.53	2.56	2.59	2.63	2.66	2.69	2.73	2.76	2.80	2.84	2.88	2.92	2.96	3.01	3.05	3.09	3.14	3.19	**30**
61	2.29	2.33	2.39	2.44	2.50	2.56	2.59	2.62	2.65	2.69	2.72	2.76	2.79	2.83	2.87	2.91	2.95	2.99	3.04	3.08	3.13	3.17	3.22	29
62	2.31	2.36	2.41	2.46	2.52	2.58	2.61	2.64	2.68	2.71	2.75	2.78	2.82	2.86	2.90	2.94	2.98	3.02	3.06	3.11	3.16	3.20	3.25	28
63	2.33	2.38	2.43	2.49	2.54	2.60	2.64	2.67	2.70	2.74	2.77	2.81	2.84	2.88	2.92	2.96	3.00	3.05	3.09	3.14	3.18	3.23	3.28	27
64	2.35	2.40	2.45	2.51	2.57	2.63	2.66	2.69	2.73	2.76	2.80	2.83	2.87	2.91	2.95	2.99	3.03	3.07	3.12	3.16	3.21	3.26	3.31	26
65	2.37	2.42	2.47	2.53	2.59	2.65	2.68	2.71	2.75	2.78	2.82	2.86	2.89	2.93	2.97	3.01	3.06	3.10	3.14	3.19	3.24	3.29	3.34	25
66	2.39	2.44	2.49	2.55	2.61	2.67	2.70	2.74	2.77	2.81	2.84	2.88	2.92	2.96	3.00	3.04	3.08	3.13	3.17	3.22	3.27	3.31	3.37	24
67	2.41	2.46	2.51	2.57	2.63	2.69	2.72	2.76	2.79	2.83	2.86	2.90	2.94	2.98	3.02	3.06	3.10	3.15	3.20	3.24	3.29	3.34	3.39	23
68	2.42	2.47	2.53	2.59	2.65	2.71	2.74	2.78	2.81	2.85	2.88	2.92	2.96	3.00	3.04	3.08	3.13	3.17	3.22	3.26	3.31	3.36	3.42	22
69	2.44	2.49	2.55	2.61	2.67	2.73	2.76	2.80	2.83	2.87	2.90	2.94	2.98	3.02	3.06	3.10	3.15	3.19	3.24	3.29	3.34	3.39	3.44	21
70	2.46	2.51	2.56	2.62	2.68	2.75	2.78	2.81	2.85	2.89	2.92	2.96	3.00	3.04	3.08	3.12	3.17	3.21	3.26	3.31	3.36	3.41	3.46	**20**
71	2.47	2.52	2.58	2.64	2.70	2.77	2.80	2.83	2.87	2.90	2.94	2.98	3.02	3.06	3.10	3.14	3.19	3.24	3.28	3.33	3.38	3.43	3.48	19
72	2.49	2.54	2.59	2.65	2.72	2.78	2.81	2.85	2.88	2.92	2.96	3.00	3.04	3.08	3.12	3.16	3.21	3.25	3.30	3.35	3.40	3.45	3.50	18
73	2.50	2.55	2.61	2.67	2.73	2.80	2.83	2.86	2.90	2.94	2.97	3.01	3.05	3.09	3.14	3.18	3.22	3.27	3.32	3.37	3.42	3.47	3.52	17
74	2.51	2.57	2.62	2.68	2.74	2.81	2.84	2.88	2.92	2.95	2.99	3.03	3.07	3.11	3.15	3.20	3.24	3.29	3.33	3.38	3.44	3.49	3.54	16
75	2.52	2.58	2.64	2.70	2.76	2.82	2.86	2.89	2.93	2.97	3.00	3.04	3.08	3.13	3.17	3.21	3.26	3.30	3.35	3.40	3.45	3.50	3.56	15
76	2.54	2.59	2.65	2.71	2.77	2.84	2.87	2.91	2.95	2.99	3.02	3.06	3.10	3.15	3.18	3.23	3.28	3.32	3.37	3.42	3.47	3.53	3.58	14
77	2.55	2.60	2.66	2.72	2.78	2.85	2.88	2.92	2.95	2.99	3.03	3.07	3.11	3.15	3.19	3.24	3.29	3.33	3.38	3.43	3.48	3.54	3.59	13
78	2.56	2.61	2.67	2.73	2.79	2.86	2.89	2.93	2.97	3.00	3.04	3.08	3.12	3.16	3.21	3.25	3.30	3.34	3.39	3.44	3.49	3.55	3.60	12
79	2.57	2.62	2.68	2.74	2.80	2.87	2.91	2.94	2.98	3.02	3.05	3.09	3.13	3.18	3.22	3.26	3.31	3.36	3.41	3.46	3.51	3.56	3.62	11
80	2.57	2.63	2.69	2.75	2.81	2.88	2.91	2.95	2.99	3.02	3.06	3.10	3.14	3.19	3.23	3.27	3.32	3.37	3.42	3.47	3.52	3.57	3.63	**10**
81	2.58	2.64	2.69	2.76	2.82	2.89	2.92	2.96	3.00	3.03	3.07	3.11	3.15	3.20	3.24	3.28	3.33	3.38	3.43	3.48	3.53	3.58	3.64	9
82	2.59	2.64	2.70	2.76	2.83	2.90	2.93	2.97	3.00	3.04	3.08	3.12	3.16	3.20	3.25	3.29	3.34	3.39	3.44	2.49	3.54	3.59	3.65	8
83	2.59	2.65	2.71	2.77	2.83	2.90	2.94	2.97	3.01	3.05	3.09	3.13	3.17	3.21	3.26	3.30	3.35	3.40	3.45	3.49	3.55	3.60	3.66	7
84	2.60	2.66	2.71	2.78	2.84	2.91	2.94	2.98	3.02	3.06	3.09	3.13	3.18	3.22	3.26	3.31	3.35	3.40	3.45	3.50	3.55	3.61	3.66	6
85	2.60	2.66	2.72	2.78	2.84	2.91	2.95	2.98	3.02	3.06	3.10	3.14	3.18	3.22	3.27	3.31	3.36	3.41	3.46	3.51	3.56	3.61	3.67	5
86	2.61	2.66	2.72	2.78	2.85	2.92	2.95	2.99	3.03	3.06	3.10	3.14	3.19	3.23	3.27	3.32	3.36	3.41	3.46	3.51	3.57	3.62	3.68	4
87	2.61	2.67	2.72	2.79	2.85	2.92	2.95	2.99	3.03	3.07	3.11	3.15	3.19	3.23	3.28	3.32	3.37	3.42	3.47	3.52	3.57	3.62	3.68	3
88	2.61	2.67	2.73	2.79	2.85	2.92	2.96	2.99	3.03	3.07	3.11	3.15	3.19	3.23	3.28	3.32	3.37	3.42	3.47	3.52	3.57	3.62	3.68	2
89	2.61	2.67	2.73	2.79	2.86	2.92	2.96	3.00	3.03	3.07	3.11	3.15	3.19	3.24	3.28	3.33	3.37	3.42	3.47	3.52	3.57	3.63	3.68	1
90	2.61	2.67	2.73	2.79	2.86	2.92	2.96	3.00	3.03	3.07	3.11	3.15	3.19	3.24	3.28	3.33	3.37	3.42	3.47	3.52	3.57	3.63	3.68	**0**

TABLE XXVIII.—*Factors for reduction of transit observations*—Continued.

Azimuth factor A = sin ζ sec. δ. Star's declination ± δ. Inclination factor B = cos ζ sec. δ.

ζ	74½°	74¾°	75°	75¼°	75½°	75¾°	76°	76¼°	76½°	76¾°	77°	77¼°	77½°	77¾°	78°	78¼°	78½°	78¾°	79°	79¼°	79½°	79¾°	80°	ζ
1°	.06	.07	.07	.07	.07	.07	.07	.07	.07	.08	.08	.08	.08	.08	.08	.09	.09	.09	.09	.09	.10	.10	.10	89
2	.13	.13	.13	.14	.14	.14	.14	.15	.15	.15	.16	.16	.16	.16	.17	.17	.18	.18	.18	.19	.19	.20	.20	88
3	.20	.20	.20	.21	.21	.21	.22	.22	.22	.23	.23	.24	.24	.25	.25	.26	.26	.27	.27	.28	.29	.29	.30	87
4	.26	.27	.27	.27	.28	.28	.29	.29	.30	.30	.31	.32	.32	.33	.34	.34	.35	.36	.37	.37	.38	.39	.40	86
5	.33	.33	.34	.34	.35	.35	.36	.37	.37	.38	.39	.40	.40	.41	.42	.43	.44	.45	.46	.47	.48	.49	.50	85
6	.39	.40	.40	.41	.42	.42	.43	.44	.45	.46	.46	.47	.49	.49	.51	.51	.52	.54	.55	.56	.57	.59	.60	84
7	.46	.46	.47	.48	.49	.50	.50	.51	.52	.53	.54	.55	.56	.57	.59	.60	.61	.62	.64	.65	.67	.69	.70	83
8	.52	.53	.54	.55	.56	.57	.58	.59	.60	.61	.62	.63	.64	.66	.67	.68	.70	.71	.73	.75	.76	.78	.80	82
9	.58	.59	.60	.61	.62	.64	.65	.66	.67	.68	.70	.71	.72	.74	.75	.77	.78	.80	.82	.84	.86	.88	.90	81
10	.65	.66	.67	.68	.69	.71	.72	.73	.74	.76	.77	.79	.80	.82	.84	.85	.87	.89	.91	.93	.95	.98	1.00	**80**
11	.71	.73	.74	.75	.76	.77	.79	.80	.82	.83	.85	.86	.88	.90	.92	.94	.96	.98	1.00	1.02	1.05	1.07	1.10	79
12	.78	.79	.80	.82	.83	.85	.86	.88	.89	.91	.92	.94	.96	.98	1.00	1.02	1.04	1.07	1.09	1.11	1.14	1.17	1.20	78
13	.84	.86	.87	.88	.90	.91	.93	.95	.96	.98	1.00	1.02	1.04	1.06	1.08	1.10	1.13	1.15	1.18	1.21	1.23	1.26	1.30	77
14	.91	.92	.94	.95	.97	.98	1.00	1.02	1.04	1.06	1.08	1.10	1.12	1.14	1.16	1.19	1.21	1.24	1.27	1.30	1.33	1.36	1.39	76
15	.97	.98	1.00	1.02	1.03	1.05	1.07	1.09	1.11	1.13	1.15	1.17	1.20	1.22	1.25	1.27	1.30	1.33	1.36	1.39	1.42	1.46	1.49	75
16	1.03	1.05	1.06	1.08	1.10	1.12	1.14	1.16	1.18	1.20	1.23	1.25	1.28	1.30	1.33	1.35	1.38	1.41	1.44	1,48	1.51	1.55	1.59	74
17	1.09	1.11	1.13	1.15	1.17	1.19	1.21	1.23	1.25	1.28	1.30	1.32	1.35	1.38	1.40	1.44	1.47	1.50	1.53	1.57	1.60	1.64	1.68	73
19	1.16	1.17	1.19	1.21	1.23	1.25	1.28	1.30	1.32	1.35	1.37	1.40	1.43	1.46	1.49	1.52	1.55	1.58	1.62	1.66	1.70	1.74	1.78	72
10	1.22	1.24	1.26	1.28	1.30	1.32	1.35	1.37	1.39	1.42	1.45	1.47	1.51	1.53	1.57	1.60	1.63	1.67	1.71	1.75	1.79	1.83	1.87	71
20	1.28	1.30	1.32	1.34	1.37	1.39	1.41	1.44	1.46	1.49	1.50	1.55	1.58	1.61	1.65	1.68	1.72	1.75	1.79	1.83	1.88	1.92	1.97	**70**
21	1.34	1.36	1.38	1.41	1.43	1.46	1.48	1.51	1.54	1.56	1.59	1.62	1.65	1.69	1.72	1.76	1.80	1.84	1.88	1.92	1.97	2.01	2.06	69
22	1.40	1.42	1.45	1.47	1.50	1.52	1.55	1.58	1.60	1.63	1.66	1.70	1.73	1.77	1.80	1.84	1.88	1.92	1.96	2.01	2.06	2.11	2.16	68
23	1.46	1.49	1.51	1.54	1.56	1.59	1.62	1.64	1.67	1.70	1.74	1.77	1.81	1.84	1.88	1.92	1.96	2.00	2.05	2.09	2.14	2.20	2.25	67
24	1.52	1.55	1.57	1.60	1.63	1.65	1.68	1.71	1.74	1.77	1.81	1.84	1.88	1.92	1.96	2.00	2.04	2.08	2.13	2.18	2.23	2.29	2.34	66
25	1.58	1.61	1.63	1.66	1.69	1.72	1.75	1.78	1.81	1.84	1.88	1.91	1.95	1.99	2.03	2.07	2.12	2.17	2.22	2.27	2.32	2.38	2.43	65
26	1.64	1.67	1.69	1.72	1.75	1.78	1.81	1.84	1.88	1.91	1.95	1.99	2.02	2.07	2.11	2.15	2.20	2.25	2.30	2.35	2.41	2.46	2.52	64
27	1.70	1.73	1.75	1.78	1.81	1.85	1.88	1.91	1.95	1.98	2.02	2.06	2.10	2.14	2.18	2.23	2.28	2.33	2.38	2.43	2.49	2.55	2.61	63
28	1.76	1.78	1.81	1.84	1.87	1.91	1.94	1.97	2.01	2.05	2.09	2.13	2.17	2.21	2.26	2.31	2.36	2.41	2.46	2.52	2.58	2.64	2.70	62
29	1.81	1.84	1.87	1.90	1.94	1.97	2.00	2.04	2.08	2.11	2.15	2.20	2.24	2.28	2.33	2.38	2.43	2.48	2.54	2.60	2.66	2.73	2.79	61
30	1.87	1.90	1.93	1.96	2.00	2.03	2.07	2.10	2.14	2.18	2.22	2.27	2.31	2.36	2.40	2.46	2.51	2.56	2.62	2.68	2.74	2.81	2.88	**60**
31	1.93	1.96	1.99	2.02	2.06	2.09	2.13	2.17	2.21	2.25	2.29	2.33	2.38	2.43	2.48	2.53	2.58	2.64	2.70	2.76	2.83	2.89	2.97	59
32	1.98	2.01	2.05	2.08	2.12	2.15	2.19	2.23	2.27	2.31	2.36	2.40	2.45	2.50	2.55	2.60	2.66	2.72	2.78	2.84	2.91	2.98	3.05	58
33	2.04	2.07	2.10	2.14	2.18	2.21	2.25	2.29	2.33	2.38	2.42	2.47	2.52	2.57	2.62	2.67	2.73	2.79	2.85	2.92	2.99	3.06	3.14	57
34	2.09	2.13	2.16	2.20	2.23	2.27	2.31	2.35	2.40	2.44	2.49	2.53	2.58	2.64	2.69	2.75	2.80	2.87	2.93	3.00	3.07	3.14	3.22	56
35	2.15	2.18	2.22	2.25	2.29	2.33	2.37	2.41	2.46	2.50	2.55	2.60	2.65	2.70	2.76	2.82	2.88	2.94	3.01	3.08	3.15	3.22	3.30	55
36	2.20	2.24	2.27	2.31	2.35	2.39	2.43	2.47	2.52	2.56	2.61	2.66	2.72	2.77	2.83	2.89	2.95	3.01	3.08	3.15	3.23	3.30	3.38	54
37	2.25	2.29	2.33	2.36	2.40	2.44	2.49	2.53	2.58	2.63	2.67	2.73	2.78	2.84	2.90	2.95	3.02	3.08	3.15	3.23	3.30	3.38	3.47	53
38	2.30	2.34	2.38	2.42	2.46	2.50	2.55	2.59	2.64	2.69	2.74	2.79	2.85	2.90	2.96	3.02	3.09	3.16	3.23	3.30	3.38	3.46	3.55	52
39	2.35	2.39	2.43	2.47	2.51	2.56	2.60	2.65	2.70	2.75	2.80	2.85	2.91	2.97	3.03	3.09	3.16	3.23	3.30	3.37	3.45	3.53	3.62	51
40	2.40	2.44	2.48	2.52	2.57	2.61	2.66	2.70	2.75	2.80	2.86	2.91	2.97	3.03	3.09	3.16	3.22	3.29	3.37	3.45	3.53	3.61	3.70	**50**
41	2.45	2.49	2.53	2.58	2.62	2.66	2.71	2.76	2.81	2.86	2.92	2.97	3.03	3.09	3.16	3.22	3.29	3.36	3.44	3.52	3.60	3.69	3.78	40
42	2.50	2.54	2.58	2.63	2.67	2.72	2.77	2.81	2.87	2.92	2.97	3.03	3.09	3.15	3.22	3.29	3.36	3.43	3.51	3.59	3.67	3.76	3.85	48
43	2.55	2.59	2.63	2.68	2.72	2.77	2.82	2.87	2.92	2.98	3.03	3.09	3.15	3.21	3.28	3.35	3.42	3.50	3.57	3.66	3.74	3.83	3.93	47
44	2.60	2.64	2.68	2.73	2.77	2.82	2.87	2.92	2.98	3.03	3.09	3.15	3.21	3.27	3.34	3.41	3.48	3.56	3.64	3.72	3.81	3.91	4.00	46
45	2.65	2.60	2.73	2.78	2.82	2.87	2.92	2.97	3.03	3.08	3.14	3.20	3.27	3.33	3.40	3.47	3.55	3.62	3.71	3.79	3.88	3.97	4.07	45

TABLE XXVIII.—*Factors for reduction of transit observations*—Continued.

Azimuth factor A=sin ζ sec. δ. Star's declination ± δ. Inclination factor B=cos ζ sec. δ.

ζ	74½°	74¾°	75°	75¼°	75½°	75¾°	76°	76¼°	76½°	76¾°	77°	77¼°	77½°	77¾°	78°	78¼°	78½°	78¾°	79°	79¼°	79½°	79¾°	80°	ζ
46°	2.69	2.73	2.78	2.82	2.87	2.92	2.97	3.03	3.08	3.14	3.20	3.26	3.32	3.39	3.46	3.53	3.61	3.69	3.77	3.86	3.95	4.04	4.14	44°
47	2.74	2.78	2.83	2.87	2.92	2.97	3.02	3.08	3.13	3.19	3.25	3.31	3.38	3.45	3.52	3.59	3.67	3.75	3.83	3.92	4.01	4.11	4.21	43
48	2.78	2.82	2.87	2.92	2.97	3.02	3.07	3.13	3.18	3.24	3.30	3.37	3.43	3.50	3.57	3.65	3.73	3.81	3.89	3.98	4.08	4.18	4.28	42
49	2.82	2.87	2.92	2.96	3.01	3.07	3.12	3.18	3.23	3.29	3.35	3.42	3.49	3.56	3.63	3.71	3.79	3.87	3.96	4.05	4.14	4.24	4.35	41
50	2.87	2.91	2.96	3.01	3.06	3.11	3.17	3.22	3.28	3.34	3.41	3.47	3.54	3.61	3.68	3.76	3.84	3.93	4.02	4.11	4.20	4.30	4.41	40
51	2.91	2.95	3.00	3.05	3.10	3.16	3.21	3.27	3.33	3.39	3.45	3.52	3.59	3.66	3.74	3.82	3.90	3.98	4.07	4.17	4.26	4.37	4.48	39
52	2.95	3.00	3.04	3.09	3.15	3.20	3.26	3.31	3.38	3.44	3.50	3.57	3.64	3.71	3.79	3.87	3.95	4.04	4.13	4.22	4.32	4.43	4.54	38
53	2.99	3.04	3.09	3.14	3.19	3.24	3.30	3.36	3.42	3.48	3.55	3.62	3.69	3.77	3.84	3.92	4.01	4.09	4.19	4.28	4.38	4.49	4.60	37
54	3.03	3.08	3.13	3.18	3.23	3.29	3.34	3.40	3.47	3.53	3.60	3.67	3.74	3.81	3.89	3.97	4.06	4.15	4.24	4.34	4.44	4.55	4.66	36
55	3.07	3.11	3.16	3.22	3.27	3.33	3.39	3.45	3.51	3.57	3.64	3.71	3.78	3.86	8.94	4.02	4.11	4.20	4.29	4.39	4.50	4.60	4.72	35
56	3.10	3.15	3.20	3.26	3.31	3.37	3.43	3.49	3.55	3.62	3.68	3.76	3.83	3.91	3.99	4.07	4.16	4.25	4.34	4.44	4.55	4.66	4.77	34
57	3.14	3.19	3.24	3.29	3.35	3.41	3.47	3.53	3.59	3.66	3.73	3.80	3.88	3.95	4.04	4.12	4.21	4.30	4.39	4.50	4.60	4.72	4.83	33
58	3.17	3.22	3.28	3.33	3.39	3.45	3.51	3.57	3.63	3.70	3.77	3.84	3.92	4.00	4.08	4.16	4.25	4.35	4.44	4.55	4.65	4.77	4.88	32
59	3.21	3.26	3.31	3.37	3.42	3.48	3.54	3.61	3.67	3.74	3.81	3.88	3.96	4.04	4.12	4.21	4.30	4.39	4.49	4.60	4.70	4.82	4.94	31
60	3.24	3.29	3.35	3.40	3.46	3.52	3.58	3.64	3.71	3.78	3.85	3.92	4.00	4.08	4.17	4.25	4.34	4.44	4.54	4.64	4.75	4.87	4.99	30
61	3.27	3.33	3.38	3.44	3.49	3.55	3.62	3.68	3.75	3.82	3.89	3.96	4.04	4.12	4.21	4.29	4.39	4.48	4.58	4.69	4.80	4.92	5.04	29
62	3.30	3.36	3.41	3.47	3.53	3.59	3.65	3.72	3.78	3.85	3.92	4.00	4.08	4.16	4.25	4.34	4.43	4.53	4.63	4.73	4.85	4.96	5.08	28
63	3.33	3.39	3.44	3.50	3.56	3.62	3.68	3.75	3.82	3.89	3.96	4.04	4.12	4.20	4.29	4.38	4.47	4.57	4.67	4.78	4.89	5.01	5.13	27
64	3.36	3.42	3.47	3.53	3.59	3.65	3.72	3.78	3.85	3.92	4.00	4.07	4.15	4.24	4.32	4.41	4.51	4.61	4.71	4.82	4.93	5.05	5.18	26
65	3.39	3.45	3.50	3.56	3.62	3.68	2.75	3.81	3.88	3.95	4.03	4.11	4.19	4.27	4.36	4.45	4.55	4.65	4.75	4.86	4.97	5.09	5.22	25
66	3.42	3.47	3.53	3.59	3.65	3.71	3.78	3.84	3.91	3.99	4.06	4.14	4.22	4.31	4.40	4.49	4.58	4.68	4.79	4.90	5.01	5.14	5.26	24
67	3.44	3.50	3.56	3.62	3.68	3.74	3.81	3.87	3.94	4.02	4.09	4.17	4.26	4.34	4.43	4.52	4.62	4.72	4.82	4.94	5.05	5.18	5.30	23
68	3.47	3.53	3.58	3.64	3.70	3.77	3.83	3.90	3.97	4.05	4.12	4.20	4.28	4.37	4.46	4.55	4.65	4.75	4.86	4.97	5.09	5.21	5.34	22
69	3.49	3.55	3.61	3.67	3.73	3.79	3.86	3.93	4.00	4.07	4.15	4.23	4.32	4.40	4.49	4.58	4.68	4.79	4.89	5.00	5.12	5.25	5.38	21
70	3.52	3.57	3.63	3.69	3.75	3.82	3.89	3.95	4.03	4.10	4.18	4.25	4.34	4.43	4.52	4.61	4.71	4.82	4.93	5.04	5.16	5.28	5.41	20
71	3.54	3.60	3.65	3.71	3.78	3.84	3.91	3.98	4.05	4.13	4.20	4.28	4.37	4.46	4.55	4.64	4.74	4.85	4.96	5.07	5.19	5.32	5.45	19
72	3.56	3.62	3.67	3.74	3.80	3.86	3.93	4.00	4.07	4.15	4.23	4.31	4.39	4.48	4.57	4.67	4.77	4.88	4.98	5.10	5.22	5.34	5.48	18
73	3.58	3.64	3.69	3.76	3.82	3.89	3.95	4.02	4.10	4.17	4.25	4.33	4.42	4.51	4.60	4.70	4.80	4.90	5.01	5.13	5.25	5.37	5.51	17
74	3.60	3.65	3.71	3.78	3.84	3.91	3.97	4.04	4.12	4.19	4.27	4.36	4.44	4.53	4.62	4.72	4.82	4.93	5.04	5.15	5.27	5.40	5.53	16
75	3.61	3.67	3.73	3.79	3.86	3.92	3.99	4.06	4.14	4.21	4.29	4.38	4.46	4.55	4.65	4.74	4.84	4.95	5.06	5.18	5.30	5.43	5.56	15
76	3.64	3.69	3.75	3.82	3.88	3.94	4.01	4.08	4.16	4.23	4.31	4.40	4.48	4.57	4.67	4.76	4.87	4.97	5.09	5.20	5.32	5.45	5.59	14
77	3.65	3.70	3.76	3.83	3.89	3.96	4.03	4.10	4.17	3.25	5.33	4.41	4.50	4.59	4.68	4.78	4.89	4.90	5.11	5.22	5.35	5.47	5.61	13
78	3.66	3.72	3.78	3.84	3.91	3.97	4.04	4.11	4.19	4.27	4.35	4.43	4.52	4.61	4.70	4.80	4.91	5.01	5.13	5.24	5.37	5.50	5.63	12
79	3.67	3.73	3.79	3.86	3.92	3.99	4.06	4.13	4.21	4.28	4.36	4.45	4.54	4.63	4.72	4.82	4.92	5.03	5.14	5.26	5.39	5.52	5.65	11
80	3.68	3.74	3.81	3.87	3.93	4.00	4.07	4.14	4.22	4.30	4.38	4.46	4.55	4.64	4.74	4.84	4.94	5.05	5.16	5.28	5.40	5.54	5.67	10
81	3.70	3.75	3.82	3.88	3.94	4.01	4.08	4.16	4.23	4.31	4.39	4.48	4.56	4.65	4.75	4.85	4.95	5.06	5.18	5.30	5.42	5.55	5.69	9
82	3.71	3.76	3.83	3.89	3.96	4.02	4.09	4.17	4.24	4.32	4.40	4.49	4.57	4.67	4.76	4.86	4.97	5.08	5.19	5.31	5.43	5.56	5.70	8
83	3.72	3.77	3.84	3.90	3.96	4.03	4.10	4.18	4.25	4.33	4.41	4.50	4.59	4.68	4.78	4.87	4.98	5.09	5.20	5.32	5.45	5.58	5.72	7
84	3.72	3.78	3.84	3.91	3.97	4.04	4.11	4.18	4.26	4.34	4.42	4.51	4.60	4.69	4.79	4.88	4.99	5.10	5.21	5.33	5.46	5.59	5.73	6
85	3.73	3.79	3.85	3.91	3.98	4.05	4.12	4.19	4.27	4.35	4.43	4.51	4.60	4.69	4.79	4.89	5.00	5.11	5.22	5.34	5.47	5.60	5.74	5
86	3.73	3.79	3.85	3.92	3.98	4.05	4.12	4.20	4.27	4.35	4.43	4.52	4.61	4.70	4.80	4.90	5.00	5.11	5.23	5.35	5.47	5.61	5.74	4
87	3.74	3.79	3.86	3.92	3.99	4.06	4.13	4.20	4.28	4.36	4.44	4.52	4.62	4.71	4.81	4.90	5.01	5.12	5.23	5.35	5.48	5.61	5.75	3
88	3.74	3.80	3.86	3.92	3.99	4.06	4.13	4.20	4.28	4.36	4.44	4.53	4.62	4.71	4.81	4.91	5.01	5.12	5.24	5.36	5.48	5.61	5.75	2
89	3.74	3.80	3.86	3.93	3.99	4.06	4.13	4.21	4.28	4.36	4.44	4.53	4.62	4.71	4.81	4.91	5.01	5.12	5.24	5.36	5.49	5.62	5.76	1
90	3.74	3.80	3.86	3.93	3.99	4.06	4.13	4.21	4.28	4.36	4.44	4.53	4.62	4.71	4.81	4.91	5.02	5.13	5.24	5.36	5.49	5.62	5.76	0

TABLE XXIX.—*For reducing observations for latitude by Talcott's method.*

[Extracted from Appendix 14. United States Coast and Geodetic Survey, Report for 1880.]

Correction for differential refraction.—The difference of refraction for any pair of stars is so small that we can neglect the variation in the state of the atmosphere at the time of the observation from that mean state supposed in the refraction tables. The refraction being nearly proportional to the tangent of the zenith-distance, the difference of refraction for the two stars will be given by—

$$r-r'=57''.7 \sin (z-z') \sec.^2 z$$

and since the difference of zenith-distances is measured by the micrometer, the following table of correction to the latitude for differential refraction has been prepared for the argument ½ difference of zenith-distance, or ½ difference of micrometer-reading on the side, and the argument "Zenith-distance" on the top. The sign of the correction is the same as that of the micrometer difference.

½ diff. in zenith-distance.	Zenith-distance.						½ diff. in zenith-distance.	Zenith-distance.					
	0°	10°	20°	25°	30°	35°		0°	10°	20°	25°	30°	35°
′	″	″	″	″	″	″	′	″	″	″	″	″	″
0	.00	.00	.00	.00	.00	.00	6.5	.11	.11	.12	.13	.14	.16
0.5	.01	.01	.01	.01	.01	.01	7	.12	.12	.13	.14	.15	.18
1	.02	.02	.02	.02	.02	.02	7.5	.13	.13	.14	.15	.16	.19
1.5	.02	.03	.03	.03	.03	.03	8	.13	.14	.15	.16	.18	.21
2	.03	.03	.04	.04	.04	.05	8.5	.14	.15	.16	.17	.19	.22
2.5	.04	.04	.05	.05	.05	.06	9	.15	.16	.17	.18	.20	.23
3	.05	.05	.06	.06	.07	.08	9.5	.16	.17	.18	.20	.21	.24
3.5	.06	.06	.07	.07	.08	.09	10	.17	.18	.19	.21	.23	.26
4	.07	.07	.08	.08	.09	.10	10.5	.18	.19	.20	.22	.24	.27
4.5	.08	.08	.09	.09	.10	.11	11	.18	.19	.21	.23	.25	.28
5	.08	.09	.10	.10	.11	.13	11.5	.19	.20	.22	.24	.26	.30
5.5	.09	.10	.10	.11	.12	.14	12	.20	.21	.23	.25	.27	.31
6	.10	.10	.11	.12	.13	.15							

Reduction to the meridian.—First, when the line of collimation of the telescope is off the meridian, the instrument having been revolved in azimuth and the star observed at the hour-angle τ, near the middle thread, then

$$m = \frac{2 \sin^2 \frac{1}{2}\tau}{\sin 1''} \cdot \frac{\cos \varphi \cos \delta}{\sin \zeta}$$

and the correction to the latitude, if the two stars are observed off the meridian $= \frac{1}{2}(m' - m)$. The value of

$$\frac{2 \sin^2 \frac{1}{2}\tau}{\sin 1''}$$

for every second of time up to two minutes (a star being rarely observed at a greater distance than this from the meridian in zenith-telescope observations) is given in the following table:

τ	Term.	τ	Term.	τ	Term.	τ	Term.	τ	Term.	τ	Term.
s.	″	s.	″	s.	″	s.	″	s.	″	s.	″
1	0.00	21	0.24	41	0.91	61	2.03	81	3.58	101	5.56
2	0.00	22	0.26	42	0.96	62	2.10	82	3.67	102	5.67
3	0.00	23	0.28	43	1.01	63	2.16	83	3.76	103	5.78
4	0.01	24	0.31	44	1.06	64	2.23	84	3.85	104	5.90
5	0.01	25	0.34	45	1.10	65	2.31	85	3.94	105	6.01
6	0.02	26	0.37	46	1.15	66	2.38	86	4.03	106	6.13
7	0.02	27	0.40	47	1.20	67	2.45	87	4.12	107	6.24
8	0.03	28	0.43	48	1.26	68	2.52	88	4.22	108	6.36
9	0.04	29	0.46	49	1.31	69	2.60	89	4.32	109	6.48
10	0.05	30	0.49	50	1.36	70	2.67	90	4.42	110	6.60
11	0.06	31	0.52	51	1.42	71	2.75	91	4.52	111	6.72
12	0.08	32	0.56	52	1.48	72	2.83	92	4.62	112	6.84
13	0.09	33	0.59	53	1.53	73	2.91	93	4.72	113	6.96
14	0.11	34	0.63	54	1.59	74	2.99	94	4.82	114	7.09
15	0.12	35	0.67	55	1.65	75	3.07	95	4.92	115	7.21
16	0.14	36	0.71	56	1.71	76	3.15	96	5.03	116	7.34
17	0.16	37	0.75	57	1.77	77	3.23	97	5.13	117	7.46
18	0.18	38	0.80	58	1.83	78	3.32	98	5.24	118	7.60
19	0.20	39	0.83	59	1.89	79	3.40	99	5.34	119	7.72
20	0.22	40	0.87	60	1.96	80	3.49	100	5.45	120	7.85

Secondly, when the star is observed off the line of collimation, the instrument remaining in the plane of the meridian, then

$$m=\frac{2\sin^2\frac{1}{2}\tau}{\sin 1''}\sin\delta\cos\delta \quad \text{or} \quad m=\frac{2\sin^2\frac{1}{2}\tau}{\sin 1''}\cdot\tfrac{1}{2}\sin 2\delta$$

and the correction to the latitude is half of this quantity, whether the star be north or south, and if the two stars forming a pair are observed off the line of collimation, two such corrections, separately computed, must be added to the latitude. If the stars should be south, of the equator, the essential sign of the correction is negative. The value of m for every 5° of declination is given in the following table:

	10*s.*	15*s.*	20*s.*	25*s.*	30*s.*	35*s.*	40*s.*	45*s.*	50*s.*	55*s.*	60*s.*	
δ	″	″	″	″	″	″	″	″	″	″	″	δ
5°	.00	.01	.02	.03	.04	.06	.08	.10	.12	.14	.17	85°
10	.01	.02	.04	.06	.08	.11	.15	.19	.23	.28	.34	80
15	.01	.03	.05	.09	.12	.17	.22	.28	.34	.41	.49	75
20	.02	.04	.07	.11	.16	.22	.28	.36	.44	.53	.63	70
25	.02	.05	.08	.13	.19	.26	.34	.42	.52	.63	.75	65
30	.02	.05	.09	.15	.21	.29	.38	.48	.59	.71	.85	60
35	.03	.06	.10	.16	.23	.31	.41	.53	.64	.77	.92	55
40	.03	.06	.11	.17	.24	.33	.43	.54	.67	.81	.97	50
45	.03	.06	.11	.17	.25	.33	.44	.55	.68	.82	.98	45

TABLE XXX.—*For facilitating the reduction of observations, on close circumpolar stars, made in determining the value of a revolution of the micrometer.*

[Extracted from Appendix 14. U. S. Coast and Geodetic Survey, Report for 1880.]

Let t=difference of time of observation and elongation of the star, and z''=number of seconds of arc in the direction of the vertical from elongation, then

$$z''=\frac{\cos\delta\sin t}{\sin 1''}$$

for which we can write

$$z''=15\cos\delta\left\{t-\tfrac{1}{6}(15\sin 1'')^2t^3\right\}$$

where t is expressed in seconds of time. It is convenient to apply the term $\frac{1}{6}(15\sin 1'')^2t^3$ to the observed time of noting, additive to the observed time before, and subtractive after, either elongation. The following table gives the value of $\frac{1}{6}(15\sin 1'')^2t^3$, also of the additional term

$-\frac{1}{120}(15\sin 1'')^4t^5$ when sensible, for every minute of time from elongation to 65^m.

t	Term.	t	Term.	t	Term.	t	Term.	t	Term.	t	Term.
m.	*s.*	*m.*	*s.*	*m.*	*s.*	*m.*	*s.*	*m.*	*s.*	*m.*	*s.*
6	0.0	16	0.8	26	3.3	36	8.9	46	18.5	56	33.3
7	0.1	17	0.9	27	3.7	37	9.6	47	19.7	57	35.1
8	0.1	18	1.1	28	4.2	38	10.4	48	21.0	58	37.0
9	0.1	19	1.3	29	4.6	39	11.3	49	22.3	59	39.0
10	0.2	20	1.5	30	5.1	40	12.2	50	23.7	60	41.0
11	0.2	21	1.8	31	5.7	41	13.1	51	25.2	61	43.1
12	0.3	22	2.0	32	6.2	42	14.1	52	26.7	62	45.2
13	0.4	23	2.3	33	6.8	43	15.1	53	28.3	63	47.4
14	0.5	24	2.6	34	7.5	44	16.2	54	29.9	64	49.7
15	0.6	25	3.0	35	8.2	45	17.3	55	31.6	65	52.1

TABLE XXXI.—*For converting intervals of sidereal into corresponding intervals of mean solar time.*

[Extracted from Lee's Tables.]

Hours.			Minutes.				Seconds.			
h.	*m.*	*s.*	*m.*	*s.*	*m.*	*s.*	*s.*	*s.*	*s.*	*s.*
1	0	09.830	1	0.164	31	5.079	1	0.003	31	0.085
2	0	19.659	2	0.328	32	5.242	2	0.005	32	0.087
3	0	29.489	3	0.491	33	5.406	3	0.008	33	0.090
4	0	39.318	4	0.655	34	5.570	4	0.011	34	0.093
5	0	49.148	5	0.819	35	5.734	5	0.014	35	0.096
6	0	58.977	6	0.983	36	5.898	6	0.016	36	0.098
7	1	08.807	7	1.147	37	6.062	7	0.019	37	0.101
8	1	18.636	8	1.311	38	6.225	8	0.022	38	0.104
9	1	28.466	9	1.474	39	6.389	9	0.025	39	0.106
10	1	38.296	10	1.638	40	6.553	10	0.027	40	0.109
11	1	48.125	11	1.802	41	6.717	11	0.030	41	0.112
12	1	57.955	12	1.966	42	6.881	12	0.033	42	0.115
13	2	07.784	13	2.130	43	7.044	13	0.036	43	0.118
14	2	17.614	14	2.294	44	7.208	14	0.038	44	0.120
15	2	27.443	15	2.457	45	7.372	15	0.041	45	0.123
16	2	37.273	16	2.621	46	7.536	16	0.044	46	0.126
17	2	47.103	17	2.785	47	7.700	17	0.047	47	0.128
18	2	56.932	18	2.949	48	7.864	18	0.049	48	0.131
19	3	06.762	19	3.113	49	8.027	19	0.052	49	0.134
20	3	16.591	20	3.277	50	8.191	20	0.055	50	0.137
21	3	26.421	21	3.440	51	8.355	21	0.057	51	0.140
22	3	36.250	22	3.604	52	8.519	22	0.060	52	0.142
23	3	46.080	23	3.768	53	8.683	23	0.063	53	0.145
24	3	55.909	24	3.932	54	8.847	24	0.066	54	0.148
			25	4.096	55	9.010	25	0.068	55	0.150
			26	4.259	56	9.174	26	0.071	56	0.153
			27	4.423	57	9.338	27	0.074	57	0.156
			28	4.587	58	9.502	28	0.076	58	0.159
			29	4.751	59	9.666	29	0.079	59	0.161
			30	4.915	60	9.830	30	0.082	60	0.164

The quantities taken from this table must be *subtracted* from a sidereal interval to obtain the corresponding interval in mean solar time.

TABLE XXXII.—*For converting intervals of mean solar time into corresponding intervals of sidereal time.*

[Extracted from Lee's Tables.]

Hours.			Minutes.				Seconds.			
h.	*m.*	*s.*	*m.*	*s.*	*m.*	*s.*	*s.*	*s.*	*s.*	*s.*
1	0	09.856	1	0.164	31	5.092	1	0.003	31	0.085
2	0	19.713	2	0.329	32	5.257	2	0.005	32	0.088
3	0	29.569	3	0.493	33	5.421	3	0.008	33	0.090
4	0	39.426	4	0.657	34	5.585	4	0.011	34	0.093
5	0	49.282	5	0.821	35	5.750	5	0.014	35	0.096
6	0	59.139	6	0.986	36	5.914	6	0.016	36	0.098
7	1	08.995	7	1.150	37	6.078	7	0.019	37	0.101
8	1	18.852	8	1.314	38	6.242	8	0.022	38	0.104
9	1	28.708	9	1.478	39	6.407	9	0.025	39	0.106
10	1	38.565	10	1.643	40	6.571	10	0.027	40	0.109
11	1	48.421	11	1.807	41	6.735	11	0.030	41	0.112
12	1	58.278	12	1.971	42	6.900	12	0.033	42	0.115
13	2	08.134	13	2.136	43	7.064	13	0.036	43	0.118
14	2	17.991	14	2.300	44	7.228	14	0.038	44	0.120
15	2	27.847	15	2.464	45	7.392	15	0.041	45	0.123
16	2	37.704	16	2.628	46	7.557	16	0.044	46	0.126
17	2	47.560	17	2.793	47	7.721	17	0.047	47	0.129
18	2	57.416	18	2.957	48	7.885	18	0.049	48	0.131
19	3	07.273	19	3.121	49	8.050	19	0.052	49	0.134
20	3	17.129	20	3.285	50	8.214	20	0.055	50	0.137
21	3	26.986	21	3.450	51	8.378	21	0.057	51	0.140
22	3	36.842	22	3.614	52	8.542	22	0.060	52	0.142
23	3	46.699	23	3.778	53	8.707	23	0.063	53	0.145
24	3	56.555	24	3.943	54	8.871	24	0.066	54	0.148
			25	4.107	55	9.035	25	0.068	55	0.151
			26	4.271	56	9.199	26	0.071	56	0.153
			27	4.436	57	9.364	27	0.074	57	0.156
			28	4.600	58	9.528	28	0.077	58	0.159
			29	4.764	59	9.692	29	0.079	59	0.161
			30	4.928	60	9.856	30	0.082	60	0.164

The quantities taken from this table must be *added* to a mean interval to obtain the corresponding interval in sidereal time.

TABLE XXXIII.—*To convert parts of the equator in arc into sidereal time, or to convert terrestrial longitude in arc into time.*

[Extracted from Lee's Tables.]

Degrees.			Degrees.			Degrees.			Degrees.			Degrees.			Degrees.		
Arc.	Time.		Arc.	Time.		Arc.	Time.		Arc.	Time.		Arc.	Time.		Arc.	Time.	
°	*h.*	*m.*	°	*h.*	*m.*	°	*h.*	*m.*	°	*h.*	*m.*	°	*h.*	*m.*	°	*h.*	*m.*
1	0	4	61	4	4	121	8	4	181	12	4	241	16	4	301	20	4
2	0	8	62	4	8	122	8	8	182	12	8	242	16	8	302	20	8
3	0	12	63	4	12	123	8	12	183	12	12	243	16	12	303	20	12
4	0	16	64	4	16	124	8	16	184	12	16	244	16	16	304	20	16
5	0	20	65	4	20	125	8	20	185	12	20	245	16	20	305	20	20
6	0	24	66	4	24	126	8	24	186	12	24	246	16	24	306	20	24
7	0	28	67	4	28	127	8	28	187	12	28	247	16	28	307	20	28
8	0	32	68	4	32	128	8	32	188	12	32	248	16	32	308	20	32
9	0	36	69	4	36	129	8	36	189	12	36	249	16	36	309	20	36
10	0	40	70	4	40	130	8	40	190	12	40	250	16	40	310	20	40
11	0	44	71	4	44	131	8	44	191	12	44	251	16	44	311	20	44
12	0	48	72	4	48	132	8	48	192	12	48	252	16	48	312	20	48
13	0	52	73	4	52	133	8	52	193	12	52	253	16	52	313	20	52
14	0	56	74	4	56	134	8	56	194	12	56	254	16	56	314	20	56
15	1	0	75	5	0	135	9	0	195	13	0	255	17	0	315	21	0
16	1	4	76	5	4	136	9	4	196	13	4	256	17	4	316	21	4
17	1	8	77	5	8	137	9	8	197	13	8	257	17	8	317	21	8
18	1	12	78	5	12	138	9	12	198	13	12	258	17	12	318	21	12
19	1	16	79	5	16	139	9	16	199	13	16	259	17	16	319	21	16
20	1	20	80	5	20	140	9	20	200	13	20	260	17	20	320	21	20
21	1	24	81	5	24	141	9	24	201	13	24	261	17	24	321	21	24
22	1	28	82	5	28	142	9	28	202	13	28	262	17	28	322	21	28
23	1	32	83	5	32	143	9	32	203	13	32	263	17	32	323	21	32
24	1	36	84	5	36	144	9	36	204	13	36	264	17	36	324	21	36
25	1	40	85	5	40	145	9	40	205	13	40	265	17	40	325	21	40
26	1	44	86	5	44	146	9	44	206	13	44	266	17	44	326	21	44
27	1	48	87	5	48	147	9	48	207	13	48	267	17	48	327	21	48
28	1	52	88	5	52	148	9	52	208	13	52	268	17	52	328	21	52
29	1	56	89	5	56	149	9	56	209	13	56	269	17	56	329	21	56
30	2	0	90	6	0	150	10	0	210	14	0	270	18	0	330	22	0
31	2	4	91	6	4	151	10	4	211	14	4	271	18	4	331	22	4
32	2	8	92	6	8	152	10	8	212	14	8	272	18	8	332	22	8
33	2	12	93	6	12	153	10	12	213	14	12	273	18	12	333	22	12
34	2	16	94	6	16	154	10	16	214	14	16	274	18	16	334	22	16
35	2	20	95	6	20	155	10	20	215	14	20	275	18	20	335	22	20
36	2	24	96	6	24	156	10	24	216	14	24	276	18	24	336	22	24
37	2	28	97	6	28	157	10	28	217	14	28	277	18	28	337	22	28
38	2	32	98	6	32	158	10	32	218	14	32	278	18	32	338	22	32
39	2	36	99	6	36	159	10	36	219	14	36	279	18	36	339	22	36
40	2	40	100	6	40	160	10	40	220	14	40	280	18	40	340	22	40
41	2	44	101	6	44	161	10	44	221	14	44	281	18	44	341	22	44
42	2	48	102	6	48	162	10	48	222	14	48	282	18	48	342	22	48
43	2	52	103	6	52	163	10	52	223	14	52	283	18	52	343	22	52
44	2	56	104	6	56	164	10	56	224	14	56	284	18	56	344	22	56
45	3	0	105	7	0	165	11	0	225	15	0	285	19	0	345	23	0
46	3	4	106	7	4	166	11	4	226	15	4	286	19	4	346	23	4
47	3	8	107	7	8	167	11	8	227	15	8	287	19	8	347	23	8
48	3	12	108	7	12	168	11	12	228	15	12	288	19	12	348	23	12
49	3	16	109	7	16	169	11	16	229	15	16	289	19	16	349	23	16
50	3	20	110	7	20	170	11	20	230	15	20	290	19	20	350	23	20
51	3	24	111	7	24	171	11	24	231	15	24	291	19	24	351	23	24
52	3	28	112	7	28	172	11	28	232	15	28	292	19	28	352	23	28
53	3	32	113	7	32	173	11	32	233	15	32	293	19	32	353	23	32
54	3	36	114	7	36	174	11	36	234	15	36	294	19	36	354	23	36
55	3	40	115	7	40	175	11	40	235	15	40	295	19	40	355	23	40
56	3	44	116	7	44	176	11	44	236	15	44	296	19	44	356	23	44
57	3	48	117	7	48	177	11	48	237	15	48	297	19	48	357	33	48
58	3	52	118	7	52	178	11	52	238	15	52	298	19	52	358	28	52
59	3	56	119	7	56	179	11	56	239	15	56	299	19	56	359	23	56
60	4	0	120	8	0	180	12	0	240	16	0	300	20	0	360	24	0

TABLE XXXIII.—*To convert parts of the equator in arc into sidereal time, or to convert terrestrial longitude in arc into time*—Continued.

[Extracted from Lee's Tables.]

Minutes.		Minutes.		Minutes.		Seconds.		Seconds.		Seconds.	
Arc.	Time.	Arc.	Time.	Arc.	Time.	Arc.	Time.	Arc.	Time.	Arc.	Time.
′	m. s.	′	m. s.	′	m. s.	″	s.	″	s.	″	s.
1	0 4	21	1 24	41	2 44	1	0.067	21	1.400	41	2.733
2	0 8	22	1 28	42	2 48	2	0.133	22	1.467	42	2.800
3	0 12	23	1 32	43	2 52	3	0.200	23	1.533	43	2.867
4	0 16	24	1 36	44	2 56	4	0.267	24	1.600	44	2.933
5	0 20	25	1 40	45	3 0	5	0.333	25	1.667	45	3.000
6	0 24	26	1 44	46	3 4	6	0.400	26	1.733	46	3.067
7	0 28	27	1 48	47	3 8	7	0.467	27	1.800	47	3.133
8	0 32	28	1 52	48	3 12	8	0.533	28	1.867	48	3.200
9	0 36	29	1 56	49	3 16	9	0.600	29	1.933	49	3.267
10	0 40	30	2 0	50	3 20	10	0.667	30	2.000	50	3.333
11	0 44	31	2 4	51	3 24	11	0.733	31	2.067	51	3.400
12	0 48	32	2 8	52	3 28	12	0.800	32	2.133	52	3.467
13	0 52	33	2 12	53	3 32	13	0.867	33	2.200	53	3.533
14	0 56	34	2 16	54	3 36	14	0.933	34	2.267	54	3.600
15	1 0	35	2 20	55	3 40	15	1.000	35	2.333	55	3.667
16	1 4	36	2 24	56	3 44	16	1.067	36	2.400	56	3.733
17	1 8	37	2 28	57	3 48	17	1.133	37	2.467	57	3.800
18	1 12	38	2 32	58	3 52	18	1.200	38	2.533	58	3.867
19	1 16	39	2 36	59	3 56	19	1.267	39	2.600	59	3.933
20	1 20	40	2 40	60	4 0	20	1.333	40	2.667	60	4.000

TABLE XXXIV.—*To convert sidereal time into parts of the equator in arc, or to convert time into terrestrial longitude in arc.*

[Extracted from Lee's Tables.]

Hours.		Minutes.				Seconds.			
Time.	Arc.	Time.	Arc.	Time.	Arc.	Time.	Arc.	Time.	Arc.
h.	°	m.	° ′	m.	° ′	s.	′ ″	s.	′ ″
1	15	1	0 15	31	7 45	1	0 15	31	7 45
2	30	2	0 30	32	8 00	2	0 30	32	8 00
3	45	3	0 45	33	8 15	3	0 45	33	8 15
4	60	4	1 00	34	8 30	4	1 00	34	8 30
5	75	5	1 15	35	8 45	5	1 15	35	8 45
6	90	6	1 30	36	9 00	6	1 30	36	9 00
7	105	7	1 45	37	9 15	7	1 45	37	9 15
8	120	8	2 00	38	9 30	8	2 00	38	9 30
9	135	9	2 15	39	9 45	9	2 15	39	9 45
10	150	10	2 30	40	10 00	10	2 30	40	10 00
11	165	11	2 45	41	10 15	11	2 45	41	10 15
12	180	12	3 00	42	10 30	12	3 00	42	10 30
13	195	13	3 15	43	10 45	13	3 15	43	10 45
14	210	14	3 30	44	11 00	14	3 30	44	11 00
15	225	15	3 45	45	11 15	15	3 45	45	11 15
16	240	16	4 00	46	11 30	16	4 00	46	11 30
17	255	17	4 15	47	11 45	17	4 15	47	11 45
18	270	18	4 30	48	12 00	18	4 30	48	12 00
19	285	19	4 45	49	12 15	19	4 45	49	12 15
20	300	20	5 00	50	12 30	20	5 00	50	12 30
21	315	21	5 15	51	12 45	21	5 15	51	12 45
22	330	22	5 30	52	13 00	22	5 30	52	13 00
23	345	23	5 45	53	13 15	23	5 45	53	13 15
24	360	24	6 00	54	13 30	24	6 00	54	13 30
		25	6 15	55	13 45	25	6 15	55	13 45
		26	6 30	56	14 00	26	6 30	56	14 00
		27	6 45	57	14 15	27	6 45	57	14 15
		28	7 00	58	14 30	28	7 00	58	14 30
		29	7 15	59	14 45	29	7 15	59	14 45
		30	7 30	60	15 00	30	7 30	60	15 00

TABLE XXXIV.—*To convert sidereal time into parts of the equator in arc, etc,*—Continued.

[Extracted from Lee's Tables.]

Tenths of seconds.										Thousandths of seconds of time.	Arc.
Time.	Arc.	Time.	Arc.	Time.	Arc.	Time.	Arc.	Time.	Arc.		
s.	″	*s.*	″	*s.*	″	*s.*	″	*s.*	″	*s.*	″
0.01	0.15	9.21	3.15	0.41	6.15	0.61	9.15	0.81	12.15	0.001	0.015
0.02	0.30	0.22	3.30	0.42	6.30	0.62	9.30	0.82	12.30	0 002	0.030
0.03	0.45	0.23	3.45	0.43	6.45	0.63	9.45	0.83	12.45	0.003	0.045
0.04	0.60	0.24	3.60	0.44	6.60	0.64	9.60	0.84	12.60	0.004	0.060
0.05	0.75	0.25	3.75	0.45	6.75	0.65	9.75	0.85	12.75	0.005	0.075
0.06	0.90	0.26	3.90	0.46	6.90	0.66	9.90	0.86	12.90	0.006	0.090
0.07	1.05	0.27	4.05	0.47	7.05	0.67	10.05	0.87	13.05	0.007	0.105
0.08	1.20	0.28	4.20	0.48	7.20	0.68	10.20	0.88	13.20	0.008	0.120
0.09	1.35	0.29	4.35	0.49	7.35	0.69	10.35	0.89	13.35	0.009	0.135
0.10	1.50	0.30	4.50	0.50	7.50	0.70	10.50	0.90	13.50	0.010	0.150
0.11	1.65	0.31	4.65	0.51	7.65	0.71	10.65	0.91	13.65		
0.12	1.80	0.32	4.80	0.52	7.80	0.72	10.80	0.92	13.80		
0.13	1.95	0.33	4.95	0.53	7.95	0.73	10.95	0.93	13.95		
0.14	2.10	0.34	5.10	0.54	8.10	0.74	11.10	0.94	14.10		
0.15	2.25	0.35	5.25	0.55	8.25	0.75	11.25	0.95	14.25		
0.16	2.40	0.36	5.40	0.56	8.40	0.76	11.40	0.96	14.40		
0.17	2.55	0.37	5.55	0.57	8.55	0.77	11.55	0.97	14.55		
0.18	2.70	0.38	5.70	0.58	8.70	0.78	11.70	0.98	14.70		
0.19	2.85	0.39	5.85	0.59	8.85	0.79	11.85	0.99	14.85		
0.20	3.00	0.40	6.00	0.60	9.00	0.80	12.00	1.00	15.00		

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000.*

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	Log.	N.	Log.	N.	Log.	N.	Log.	N.	Log.
0	—	**20**	1.30 103	**40**	1.60 206	**60**	1.77 815	**80**	1.90 309
1	0.00 000	21	1.32 222	41	1.61 278	61	1.78 533	81	1.90 849
2	0.30 103	22	1.34 242	42	1.62 325	62	1.79 239	82	1.91 381
3	0.47 712	23	1.36 173	43	1.63 347	63	1.79 934	83	1.91 908
4	0.60 206	24	1.38 021	44	1.64 345	64	1.80 618	84	1.92 428
5	0.69 897	25	1.39 794	45	1.65 321	65	1.81 291	85	1.92 942
6	0.77 815	26	1.41 497	46	1.66 276	66	1.81 954	86	1.93 450
7	0.84 510	27	1.43 136	47	1.67 210	67	1.82 607	87	1.93 952
8	0.90 309	28	1.44 716	48	1.68 124	68	1.83 251	88	1.94 448
9	0.95 424	29	1.46 240	49	1.69 020	69	1.83 885	89	1.94 939
10	1.00 000	**30**	1.47 712	**50**	1.69 897	**70**	1.84 510	**90**	1.95 424
11	1.04 139	31	1.49 136	51	1.70 757	71	1.85 126	91	1.95 904
12	1.07 918	32	1.50 515	52	1.71 600	72	1.85 733	92	1.96 379
13	1.11 394	33	1.51 851	53	1.72 428	73	1.86 332	93	1.96 848
14	1.14 613	34	1.53 148	54	1.73 239	74	1.86 923	94	1.97 313
15	1.17 609	35	1.54 407	55	1.74 036	75	1.87 506	95	1.97 772
16	1.20 412	36	1.55 630	56	1.74 819	76	1.88 081	96	1.98 227
17	1.23 045	37	1.56 820	57	1.75 587	77	1.88 649	97	1.98 677
18	1.25 527	38	1.57 978	58	1.76 343	78	1.89 209	98	1.99 123
19	1.27 875	39	1.59 106	59	1.77 085	79	1.89 763	99	1.99 564
20	1.30 103	**40**	1.69 206	**60**	1.77 815	**80**	1.90 309	**100**	2.00 000

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9
0		00 000	30 103	47 712	60 206	69 897	77 815	84 510	90 309	95 424
1	00 000	04 139	07 918	11 394	14 613	17 609	20 412	23 045	25 527	27 875
2	30 103	32 222	34 242	36 173	38 021	39 794	41 497	43 136	44 716	46 240
3	47 712	49 136	50 515	51 851	53 148	54 407	55 630	56 820	57 978	59 106
4	60 206	61 278	62 325	63 347	64 345	65 321	66 276	67 210	68 124	69 020
5	69 897	70 757	71 600	72 428	73 239	74 036	74 819	75 587	76 343	77 085
6	77 815	78 533	79 239	79 934	80 618	81 291	81 954	82 607	83 251	83 885
7	84 510	85 126	85 733	86 332	86 923	87 506	88 081	88 649	89 209	89 763
8	90 309	90 849	91 381	91 908	92 428	92 942	93 450	93 952	94 448	94 939
9	95 424	95 904	96 379	96 848	97 313	97 772	98 227	98 677	99 123	99 564
10	00 000	00 432	00 860	01 284	01 703	02 119	02 531	02 938	03 342	03 743
11	04 139	04 532	04 922	05 308	05 690	06 070	06 446	06 819	07 188	07 555
12	07 918	08 279	08 636	08 991	09 342	09 691	10 037	10 380	10 721	11 059
13	11 394	11 727	12 057	12 385	12 710	13 033	13 354	13 672	13 988	14 301
14	14 613	14 922	15 229	15 534	15 836	16 137	16 435	16 732	17 026	17 319
15	17 609	17 898	18 184	18 469	18 752	19 033	19 312	19 590	19 866	20 140
16	20 412	20 683	20 952	21 219	21 484	21 748	22 011	22 272	22 531	22 789
17	23 045	23 300	23 553	23 805	24 055	24 304	24 551	24 797	25 042	25 285
18	25 527	25 768	26 007	26 245	26 482	26 717	26 951	27 184	27 416	27 646
19	27 875	28 103	28 330	28 556	28 780	29 003	29 226	29 447	29 667	29 885
20	30 103	30 320	30 535	30 750	30 963	31 175	31 387	31 597	31 806	32 015
21	32 222	32 428	32 634	32 838	33 041	33 244	33 445	33 646	33 846	34 044
22	34 242	34 439	34 635	34 830	35 025	35 218	35 411	35 603	35 793	35 984
23	36 173	36 361	36 549	36 736	36 922	37 107	37 291	37 475	37 658	37 840
24	38 021	38 202	38 382	38 561	38 739	38 917	39 094	39 270	39 445	39 620
25	39 794	39 967	40 140	40 312	40 483	40 654	40 824	40 993	41 162	41 330
26	41 497	41 664	41 830	41 996	42 160	42 325	42 488	42 651	42 813	42 975
27	43 136	43 297	43 457	43 616	43 775	43 933	44 091	44 248	44 404	44 560
28	44 716	44 871	45 025	45 179	45 332	45 484	45 637	45 788	45 939	46 090
29	46 240	46 389	46 538	46 687	46 835	46 982	47 129	47 276	47 422	47 567
30	47 712	47 857	48 001	48 144	48 287	48 430	48 572	48 714	48 855	48 996
31	49 136	49 276	49 415	49 554	49 693	49 831	49 969	50 106	50 243	50 379
32	50 515	50 651	50 786	50 920	51 055	51 188	51 322	51 455	51 587	51 720
33	51 851	51 983	52 114	52 244	52 375	52 504	52 634	52 763	52 892	53 020
34	53 148	53 275	53 403	53 529	53 656	53 782	53 908	54 033	54 158	54 283
35	54 407	54 531	54 654	54 777	54 900	55 023	55 145	55 267	55 388	55 509
36	55 630	55 751	55 871	55 991	56 110	56 229	56 348	56 467	56 585	56 703
37	56 820	56 937	57 054	57 171	57 287	57 403	57 519	57 634	57 749	57 864
38	57 978	58 092	58 206	58 320	58 433	58 546	58 659	58 771	58 883	58 995
39	59 106	59 218	59 329	59 439	59 550	59 660	59 770	59 879	59 988	60 097
40	60 206	60 314	60 423	60 531	60 638	60 746	60 853	60 959	61 066	61 172
41	61 278	61 384	61 490	61 595	61 700	61 805	61 909	62 014	62 118	62 221
42	62 325	62 428	62 531	62 634	62 737	62 839	62 941	63 043	63 144	63 246
43	63 347	63 448	63 548	63 649	63 749	63 849	63 949	64 048	64 147	64 246
44	64 345	64 444	64 542	64 640	64 738	64 836	64 933	65 031	65 128	65 225
45	65 321	65 418	65 514	65 610	65 706	65 801	65 896	65 992	66 087	66 181
46	66 276	66 370	66 464	66 558	66 652	66 745	66 839	66 932	67 025	67 117
47	67 210	67 302	67 394	67 486	67 578	67 669	67 761	67 852	67 943	68 034
48	68 124	68 215	68 305	68 395	68 485	68 574	68 664	68 753	68 842	68 931
49	69 020	69 108	69 197	69 285	69 373	69 461	69 548	69 636	69 723	69 810
50	69 897	69 984	70 070	70 157	70 243	70 329	70 415	70 501	70 586	70 672
N.	L. 0	1	2	3	4	5	6	7	8	9

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9
50	69 897	69 984	70 070	70 157	70 243	70 329	70 415	70 501	70 586	70 672
51	70 757	70 842	70 927	71 012	71 096	71 181	71 265	71 349	71 433	71 517
52	71 600	71 684	71 767	71 850	71 933	72 016	72 099	72 181	72 263	72 346
53	72 428	72 509	72 591	72 673	72 754	72 835	72 916	72 997	73 078	73 159
54	73 239	73 320	73 400	73 480	73 560	73 640	73 719	73 799	73 878	73 957
55	74 036	74 115	74 194	74 273	74 351	74 429	74 507	74 586	74 663	74 741
56	74 819	74 896	74 974	75 051	75 128	75 205	75 282	75 358	75 435	75 511
57	75 587	75 664	75 740	75 815	75 891	75 967	76 042	76 118	76 193	76 268
58	76 343	76 418	76 492	76 567	76 641	76 716	76 790	76 864	76 938	77 012
59	77 085	77 159	77 232	77 305	77 379	77 452	77 525	77 597	77 670	77 743
60	77 815	77 887	77 960	78 032	78 104	78 176	78 247	78 319	78 390	78 462
61	78 533	78 604	78 675	78 746	78 817	78 888	78 958	79 029	79 099	79 169
62	79 239	79 309	79 379	79 449	79 518	79 588	79 657	79 727	79 796	79 865
63	79 934	80 003	80 072	80 140	80 209	80 277	80 346	80 414	80 482	80 550
64	80 618	80 686	80 754	80 821	80 889	80 956	81 023	81 090	81 158	81 224
65	81 291	81 358	81 425	81 491	81 558	81 624	81 690	81 757	81 823	81 889
66	81 954	82 020	82 086	82 151	82 217	82 282	82 347	82 413	82 478	82 543
67	82 607	82 672	82 737	82 802	82 866	82 930	82 995	83 059	83 123	83 187
68	83 251	83 315	83 378	83 442	83 506	83 569	83 632	83 696	83 759	83 822
69	83 885	83 948	84 011	84 073	84 136	84 198	84 261	84 323	84 386	84 448
70	84 510	84 572	84 634	84 696	84 757	84 819	84 880	84 942	85 003	85 065
71	85 126	85 187	85 248	85 309	85 370	85 431	85 491	85 552	85 612	85 673
72	85 733	85 794	85 854	85 914	85 974	86 034	86 094	86 153	86 213	86 273
73	86 332	86 392	86 451	86 510	86 570	86 629	86 688	86 747	86 806	86 864
74	86 923	86 982	87 040	87 099	87 157	87 216	87 274	87 332	87 390	87 448
75	87 506	87 564	87 622	87 679	87 737	87 795	87 852	87 910	87 967	88 024
76	88 081	88 138	88 195	88 252	88 309	88 366	88 423	88 480	88 536	88 593
77	88 649	88 705	88 762	88 818	88 874	88 930	88 986	89 042	89 098	89 154
78	89 209	89 265	89 321	89 376	89 432	89 487	89 542	89 597	89 653	89 708
79	89 763	89 818	89 873	89 927	89 982	90 037	90 091	90 146	90 200	90 255
80	90 309	90 363	90 417	90 472	90 526	90 580	90 634	90 687	90 741	90 795
81	90 849	90 902	90 956	91 009	91 062	91 116	91 169	91 222	91 275	91 328
82	91 381	91 434	91 487	91 540	91 593	91 645	91 698	91 751	91 803	91 855
83	91 908	91 960	92 012	92 065	92 117	92 169	92 221	92 273	92 324	92 376
84	92 428	92 480	92 531	92 583	92 634	92 686	92 737	92 788	92 840	92 891
85	92 942	92 993	93 044	93 095	93 146	93 197	93 247	93 298	93 349	93 399
86	93 450	93 500	93 551	93 601	93 651	93 702	93 752	93 802	93 852	93 902
87	93 952	94 002	94 052	94 101	94 151	94 201	94 250	94 300	94 349	94 399
88	94 448	94 498	94 547	94 596	94 645	94 694	94 743	94 792	94 841	94 890
89	94 939	94 988	95 036	95 085	95 134	95 182	95 231	95 279	95 328	95 376
90	95 424	95 472	95 521	95 569	95 617	95 665	95 713	95 761	95 809	95 856
91	95 904	95 952	95 999	96 047	96 095	96 142	96 190	96 237	96 284	96 332
92	96 379	96 426	96 473	96 520	96 567	96 614	96 661	96 708	96 755	96 802
93	96 848	96 895	96 942	96 988	97 035	97 081	97 128	97 174	97 220	97 267
94	97 313	97 359	97 405	97 451	97 497	97 543	97 589	97 635	97 681	97 727
95	97 772	97 818	97 864	97 909	97 955	98 000	98 046	98 091	98 137	98 182
96	98 227	98 272	98 318	98 363	98 408	98 453	98 498	98 543	98 588	98 632
97	98 677	98 722	98 767	98 811	98 856	98 900	98 945	98 989	99 034	99 078
98	99 123	99 167	99 211	99 255	99 300	99 344	99 388	99 432	99 476	99 520
99	99 564	99 607	99 651	99 695	99 739	99 782	99 826	99 870	99 913	99 957
100	00 000	00 043	00 087	00 130	00 173	00 217	00 260	00 303	00 346	00 389
N.	L. 0	1	2	3	4	5	6	7	8	9

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.			
100	00 000	043	087	130	173	217	260	303	346	389				
101	432	475	518	561	604	647	689	732	775	817		**44**	**43**	**42**
102	860	903	945	988	*030	*072	*115	*157	*199	*242	1	4,4	4,3	4,2
103	01 284	326	368	410	452	494	536	578	620	662	2	8,8	8,6	8,4
104	703	745	787	828	870	912	953	995	*036	*078	3	13,2	12,9	12'6
105	02 119	160	202	243	284	325	366	407	449	490	4	17,6	17,2	16,8
106	531	572	612	653	694	735	776	816	857	898	5	22,0	21,5	21,0
107	938	979	*019	*060	*100	*141	*181	*222	*262	*302	6	26,4	25,8	25,2
108	03 342	383	423	463	503	543	583	623	663	703	7	30,8	30,1	29,4
109	743	782	822	862	902	941	981	*021	*060	*100	8	35,2	34,4	33,6
110	04 139	179	218	258	297	336	376	415	454	493	9	39,6	38,7	37,8
111	532	571	610	650	689	727	766	805	844	883		**41**	**40**	**39**
112	922	961	999	*038	*077	*115	*154	*192	*231	*269	1	4,1	4,0	3,9
113	05 308	346	385	423	461	500	538	576	614	652	2	8,2	8,0	7,8
114	690	729	767	805	843	881	918	956	994	*032	3	12,3	12,0	11,7
115	06 070	108	145	183	221	258	296	333	371	408	4	16,4	16,0	15,6
116	446	483	521	558	595	633	670	707	744	781	5	20,5	20,0	19,5
117	819	856	893	930	967	*004	*041	*078	*115	*151	6	24,6	24,0	23,4
118	07 188	225	262	298	335	372	408	445	482	518	7	28,7	28,0	27,3
119	555	591	628	664	700	737	773	809	846	882	8	32,8	32,0	31,2
120	918	954	090	*027	*063	*099	*135	*171	*207	*243	9	36,9	36,0	35,1
121	08 279	314	350	386	422	458	493	529	565	600		**38**	**37**	**36**
122	636	672	707	743	778	814	849	884	920	955	1	3,8	3,7	3,6
123	991	*026	*061	*096	*132	*167	*202	*237	*272	*307	2	7,6	7,4	7,2
124	09 342	377	412	447	482	517	552	587	621	656	3	11,4	11,1	10,8
125	691	726	760	795	830	864	899	934	968	*003	4	15,2	14,8	14,4
126	10 037	072	106	140	175	209	243	278	312	346	5	19,0	18,5	18,0
127	380	415	449	483	517	551	585	619	653	687	6	22,8	22,2	21,6
128	721	755	789	823	857	890	924	958	992	*025	7	26,6	25,9	25,2
129	11 059	093	126	160	193	227	261	294	327	361	8	30,4	29,6	28,8
130	394	428	461	494	528	561	594	628	661	694	9	34,2	33,3	32,4
131	727	760	793	826	860	893	926	959	992	*024		**35**	**34**	**33**
132	12 057	090	123	156	189	222	254	287	320	352	1	3,5	3,4	3,3
133	385	418	450	483	516	548	581	613	646	678	2	7,0	6,8	6,6
134	710	743	775	808	840	872	905	937	969	*001	3	10,5	10,2	9,9
135	13 033	066	098	130	162	194	226	258	290	322	4	14,0	13,6	13,2
136	354	386	418	450	481	513	545	577	609	640	5	17,5	17,0	16,5
137	672	704	735	767	799	830	862	893	925	956	6	21,0	20,4	19,8
138	988	*019	*051	*082	*114	*145	*176	*208	*239	*270	7	24,5	23,8	23,1
139	14 301	333	364	395	426	457	489	520	551	582	8	28,0	27,2	26,4
140	613	644	675	706	737	768	709	829	860	891	9	31,5	30,6	29,7
141	922	953	983	*014	*045	*076	*106	*137	*168	*198		**32**	**31**	**30**
142	15 229	259	290	320	351	381	412	442	473	503	1	3,2	3,1	3,0
143	534	564	594	625	655	685	715	746	776	806	2	6,4	6,2	6,0
144	836	866	897	927	957	987	*017	*047	*077	*107	3	9,6	9,3	9'0
145	16 137	167	197	227	256	286	316	346	376	406	4	12,8	12,4	12,0
146	435	465	495	524	554	584	613	643	673	702	5	16,0	15,5	15,0
147	732	761	791	820	850	879	909	938	967	997	6	19,2	18,6	18,0
148	17 026	056	085	114	143	173	202	231	260	289	7	22,4	21,7	21,0
149	319	348	377	406	435	464	493	522	551	580	8	25,6	24,8	24,0
150	609	638	667	696	725	754	782	811	840	869	9	28,8	27,9	27,0
N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.			

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.		
150	17 609	638	667	696	725	754	782	811	840	869			
151	898	926	955	984	*013	*041	*070	*099	*127	*156		**29**	**28**
152	18 184	213	241	270	298	327	355	384	412	441	1	2,9	2,8
153	469	498	526	554	583	611	639	667	696	724	2	5,8	5,6
154	752	780	808	837	865	893	921	949	977	*005	3	8,7	8,4
155	19 033	061	089	117	145	173	201	229	257	285	4	11,6	11,2
156	312	340	368	396	424	451	479	507	535	562	5	14,5	14,0
157	590	618	645	673	700	728	756	783	811	838	6	17,4	16,8
158	866	893	921	948	976	*003	*030	*058	*085	*112	7	20,3	19,6
159	20 140	167	194	222	249	276	303	330	358	385	8	23,2	22,4
160	412	439	466	493	520	548	575	602	629	656	9	26,1	25,2
161	683	710	737	763	790	817	844	871	898	925		**27**	**26**
162	952	978	*005	*032	*059	*085	*112	*139	*165	*192	1	2,7	2,6
163	21 219	245	272	299	325	352	378	405	431	458	2	5,4	5,2
164	484	511	537	564	590	617	643	669	696	722	3	8,1	7,8
165	748	775	801	827	854	880	906	932	958	985	4	10,8	10,4
166	22 011	037	063	089	115	141	167	194	220	246	5	13,5	13,0
167	272	298	324	350	376	401	427	453	479	505	6	16,2	15,6
168	531	557	583	608	634	660	686	712	737	763	7	18,9	18,2
169	789	814	840	866	891	917	943	968	994	*019	8	21,6	20,8
170	23 045	070	096	121	147	172	198	223	249	274	9	24,3	23,4
171	300	325	350	376	401	426	452	477	502	528		**25**	
172	553	578	603	629	654	679	704	729	754	779	1	2,5	
173	805	830	855	880	905	930	955	980	*005	*030	2	5,0	
174	24 055	080	105	130	155	180	204	229	254	279	3	7,5	
175	304	329	353	378	403	428	452	477	502	527	4	10,0	
176	551	576	601	625	650	674	699	724	748	773	5	12,5	
177	797	822	846	871	895	920	944	969	993	*018	6	15,0	
178	25 042	066	091	115	139	164	188	212	237	261	7	17,5	
179	285	310	334	358	382	406	431	455	479	503	8	20,0	
180	527	551	575	600	624	648	672	696	720	744	9	22,5	
181	768	792	816	840	864	888	912	935	959	983		**24**	**23**
182	26 007	031	055	079	102	126	150	174	198	221	1	2,4	2,3
183	245	269	293	316	340	364	387	411	435	458	2	4,8	4,6
184	482	505	529	553	576	600	623	647	670	694	3	7,2	6,9
185	717	741	764	788	811	834	858	881	905	928	4	9,6	9,2
186	951	975	998	*021	*045	*068	*091	*114	*138	*161	5	12,0	11,5
187	27 184	207	231	254	277	300	323	346	370	393	6	14,4	13,8
188	416	439	462	485	508	531	554	577	600	623	7	16,8	16,1
189	646	669	692	715	738	761	784	807	830	852	8	19,2	18,4
190	875	898	921	944	967	989	*012	*035	*058	*081	9	21,6	20,7
191	28 103	126	149	171	194	217	240	262	285	307		**22**	**21**
192	330	353	375	398	421	443	466	488	511	533	1	2,2	2,1
193	556	578	601	623	646	668	691	713	735	758	2	4,4	4,2
194	780	803	825	847	870	892	914	937	959	981	3	6,6	6,3
195	29 003	026	048	070	092	115	137	159	181	203	4	8,8	8,4
196	226	248	270	292	314	336	358	380	403	425	5	11,0	10,5
197	447	469	491	513	535	557	579	601	623	645	6	13,2	12,6
198	667	688	710	732	754	776	798	820	842	863	7	15,4	14,7
199	885	907	929	951	973	994	*016	*038	*060	*081	8	17,6	16,8
200	30 103	125	146	168	190	211	233	255	276	298	9	19,8	18,9
N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.		

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0.	1	2	3	4	5	6	7	8	9	P.P.		
200	30 103	125	146	168	190	211	233	255	276	298			
201	320	341	363	384	406	428	449	471	492	514		**22**	**21**
202	535	557	578	600	621	643	664	685	707	728	1	2,2	2,1
203	750	771	792	814	835	856	878	899	920	942	2	4,4	4,2
204	963	984	*006	*027	*048	*069	*091	*112	*133	*154	3	6,6	6,3
205	31 175	197	218	239	260	281	302	323	345	366	4	8,8	8,4
206	387	408	429	450	471	492	513	534	555	576	5	11,0	10,5
207	597	618	639	660	681	702	723	744	765	785	6	13,2	12,6
208	806	827	848	869	890	911	931	952	973	994	7	15,4	14,7
209	32 015	035	056	077	098	118	139	160	181	201	8	17,6	16,8
210	222	243	263	284	305	325	346	366	387	408	9	19,8	18,9
211	428	449	469	490	510	531	552	572	593	613		**20**	
212	634	654	675	695	715	736	756	777	797	818	1	2,0	
213	838	858	879	899	919	940	960	980	*001	*021	2	4,0	
214	33 041	062	082	102	122	143	163	183	203	224	3	6,0	
215	244	264	284	304	325	345	365	385	405	425	4	8,0	
216	445	465	486	506	526	546	566	586	606	626	5	10,0	
217	646	666	686	706	726	746	766	786	806	826	6	12,0	
218	846	866	885	905	925	945	965	985	*005	*025	7	14,0	
219	34 044	064	084	104	124	143	163	183	203	223	8	16,0	
220	242	262	282	301	321	341	361	380	400	420	9	18,0	
221	439	459	479	498	518	537	557	577	596	616		**19**	
222	635	655	674	694	713	733	753	772	792	811	1	1,9	
323	830	850	869	889	908	928	947	967	986	*005	2	3,8	
224	35 025	044	064	083	102	122	141	160	180	199	3	5,7	
225	218	238	257	276	295	315	334	353	372	392	4	7,6	
226	411	430	449	468	488	507	526	545	564	583	5	9,5	
227	603	622	641	660	679	698	717	736	755	774	6	11,4	
228	793	813	832	851	870	889	908	927	946	965	7	13,3	
229	984	*003	*021	*040	*059	*078	*097	*116	*135	*154	8	15,2	
230	36 173	192	211	229	248	267	286	305	324	342	9	17,1	
231	361	380	399	418	436	455	474	493	511	530		**18**	
232	549	568	586	605	624	642	661	680	698	717	1	1,8	
233	736	754	773	791	810	829	847	866	884	903	2	3,6	
234	922	940	959	977	996	*014	*033	*051	*070	*088	3	5,4	
235	37 107	125	144	162	181	199	218	236	254	273	4	7,2	
236	291	310	328	346	365	383	401	420	438	457	5	9,0	
237	475	493	511	530	548	566	585	603	621	639	6	10,8	
238	658	676	694	712	731	749	767	785	803	822	7	12,6	
239	840	858	876	894	912	931	949	967	985	*003	8	14,4	
240	38 021	039	057	075	093	112	130	148	166	184	9	16,2	
241	202	220	238	256	274	292	310	328	346	364		**17**	
242	382	399	417	435	453	471	489	507	525	543	1	1,7	
243	561	578	596	614	632	650	668	686	703	721	2	3,4	
244	739	757	775	792	810	828	846	863	881	890	3	5,1	
245	917	934	952	970	987	*005	*023	*041	*058	*076	4	6,8	
246	39 094	111	129	146	164	182	199	217	235	252	5	8,5	
247	270	287	305	322	340	358	375	393	410	428	6	10,2	
248	445	463	480	498	515	533	550	568	585	602	7	11,9	
249	620	637	655	672	690	707	724	742	759	777	8	13,6	
250	794	811	829	846	863	881	898	915	933	950	9	15,3	
N.	L. 0.	1	2	3	4	5	6	7	8	9	P.P.		

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—**Continued.**

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.	
250	39 794	811	829	846	863	881	898	915	933	950		**18**
251	967	985	*002	*019	*037	*054	*071	*088	*106	*123	1	1,8
252	40 140	157	175	192	209	226	243	261	278	295	2	3,6
253	312	329	346	364	381	398	415	432	449	466	3	5,4
254	483	500	518	535	552	569	586	603	620	637	4	7,2
255	654	671	688	705	722	739	756	773	790	807	5	9,0
256	824	841	858	875	892	909	926	943	960	976	6	10,8
257	993	*010	*027	*044	*061	*078	*095	*111	*128	*145	7	12,6
258	41 162	179	196	212	229	246	263	280	296	313	8	14,4
259	330	347	363	380	397	414	430	447	464	481	9	16,2
260	497	514	531	547	564	581	597	614	631	647		**17**
261	664	681	697	714	731	747	764	780	797	814	1	1,7
262	830	847	863	880	896	913	929	946	963	979	2	3,4
263	996	*012	*029	*045	*062	*078	*095	*111	*127	*144	3	5,1
264	42 160	177	193	210	226	243	259	275	292	308	4	6,8
265	325	341	357	374	390	406	423	439	455	472	5	8,5
266	488	504	521	537	553	570	586	602	619	635	6	10,2
267	651	667	684	700	716	732	749	765	781	797	7	11,9
268	813	830	846	862	878	894	911	927	943	959	8	13,6
269	975	991	*008	*024	*040	*056	*072	*088	*104	*120	9	15,3
270	43 136	152	169	185	201	217	233	249	265	281		**16**
271	297	313	329	345	361	377	393	409	425	441	1	1,6
272	457	473	489	505	521	537	553	569	584	600	2	3,2
273	616	632	648	664	680	696	712	727	743	759	2	4,8
274	775	791	807	823	838	854	870	886	902	917	4	6,4
275	933	949	965	981	996	*012	*028	*044	*059	*075	5	8,0
276	44 091	107	122	138	154	170	185	201	217	232	6	9,6
277	248	264	279	295	311	326	342	358	373	389	7	11,2
278	404	420	436	451	467	483	498	514	529	545	8	12,8
279	560	576	592	607	623	638	654	669	685	700	9	14,4
280	716	731	747	762	778	793	809	824	840	855		**15**
281	871	886	902	917	932	948	963	979	994	*010	1	1,5
282	45 025	040	056	071	086	102	117	133	148	163	2	3,0
283	179	194	209	225	240	255	271	286	301	317	3	4,5
284	332	347	362	378	393	408	423	439	454	469	4	6,0
285	484	500	515	530	545	561	576	591	606	621	5	7,5
286	637	652	667	682	697	712	728	743	758	773	6	9,0
287	788	803	818	834	849	864	879	894	909	924	7	10,5
288	939	954	969	984	*000	*015	*030	*045	*060	*075	8	12,0
289	46 090	105	120	135	150	165	180	195	210	225	9	13,5
290	240	255	270	285	300	315	330	345	359	374		**14**
291	389	404	419	434	449	464	479	494	509	523	1	1,4
292	538	553	568	583	598	613	627	642	657	672	2	2,8
293	687	702	716	731	746	761	776	790	805	820	3	4,2
294	835	850	864	879	894	909	923	938	953	967	4	5,6
295	982	997	*012	*026	*041	*056	*070	*085	*100	*114	5	7,0
296	47 129	144	159	173	188	202	217	232	246	261	6	8,4
297	276	290	305	319	334	349	363	378	392	407	7	9,8
298	422	436	451	465	480	494	509	524	538	553	8	11,2
299	567	582	596	611	625	640	654	669	683	698	9	12,6
300	712	727	741	756	770	784	799	813	828	842		
N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.	

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9
300	47 712	727	741	756	770	784	799	813	828	842
301	857	871	885	900	914	929	943	958	972	986
302	48 001	015	029	044	058	073	087	101	116	130
303	144	159	173	187	202	216	230	244	259	273
304	287	302	316	330	344	359	373	387	401	416
305	430	444	458	473	487	501	515	530	544	558
306	572	586	601	615	629	643	657	671	686	700
307	714	728	742	756	770	785	799	813	827	841
308	855	869	883	897	911	926	940	954	968	982
309	996	*010	*024	*038	*052	*066	*080	*094	*108	*122
310	49 136	150	164	178	192	206	220	234	248	262
311	276	290	304	318	332	346	360	374	388	402
312	415	429	443	457	471	485	499	513	527	541
313	554	568	582	596	610	624	638	651	665	679
314	693	707	721	734	748	762	776	790	803	817
315	831	845	859	872	886	900	914	927	941	955
316	969	982	996	*010	*024	*037	*051	*065	*079	*092
317	50 106	120	133	147	161	174	188	202	215	229
318	243	256	270	284	297	311	325	338	352	365
319	379	393	406	420	433	447	461	474	488	501
320	515	529	542	556	569	583	596	610	623	637
321	651	664	678	691	705	718	732	745	759	772
322	786	799	813	826	840	853	866	880	893	907
323	920	934	947	961	974	987	*001	*014	*028	*041
324	51 055	068	081	095	108	121	135	148	162	175
325	188	202	215	228	242	255	268	282	295	308
326	322	335	348	362	375	388	402	415	428	441
327	455	468	481	495	508	521	534	548	561	574
328	587	601	614	627	640	654	667	680	693	706
329	720	733	746	759	772	786	799	812	825	838
330	851	865	878	891	904	917	930	943	957	970
331	983	996	*009	*022	*035	*048	*061	*075	*088	*101
332	52 114	127	140	153	166	179	192	205	218	231
333	244	257	270	284	297	310	323	336	349	362
334	375	388	401	414	427	440	453	466	479	492
335	504	517	530	543	556	569	582	595	608	621
336	634	647	660	673	686	699	711	724	737	750
337	763	776	789	802	815	827	840	853	866	879
338	892	905	917	930	943	956	969	982	994	*007
339	53 020	033	046	058	071	084	097	110	122	135
340	148	161	173	186	199	212	224	237	250	263
341	275	288	301	314	326	339	352	364	377	390
342	403	415	428	441	453	466	479	491	504	517
343	529	542	555	567	580	593	605	618	631	643
344	656	668	681	694	706	719	732	744	757	769
345	782	794	807	820	832	845	857	870	882	895
346	908	920	933	945	958	970	983	995	*008	*020
347	54 033	045	058	070	083	095	108	120	133	145
348	158	170	183	195	208	220	233	245	258	270
349	283	295	307	320	332	345	357	370	382	394
350	407	419	432	444	456	469	481	494	506	518
N.	L. 0	1	2	3	4	5	6	7	8	9

P. P.

	15	**14**	**13**	**12**
1	1,5	1,4	1,3	1,2
2	3,0	2,8	2,6	2,4
3	4,5	4,2	3,9	3,6
4	6,0	5,6	5,2	4,8
5	7,5	7,0	6,5	6,0
6	9,0	8,4	7,8	7,2
7	10,5	9,8	9,1	8,4
8	12,0	11,2	10,4	9,6
9	13,5	12,6	11,7	10,8

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.
350	54 407	419	432	444	456	469	481	494	506	518	
351	531	543	555	568	580	593	605	617	630	642	
352	654	667	679	691	704	716	728	741	753	765	**13**
353	777	790	802	814	827	839	851	864	876	888	
354	900	913	925	937	949	962	974	986	998	*011	1 | 1,3
355	55 023	035	047	060	072	084	096	108	121	133	2 | 2,6
356	145	157	169	182	194	206	218	230	242	255	3 | 3,9
357	267	279	291	303	315	328	340	352	364	376	4 | 5,2
358	388	400	413	425	437	449	461	473	485	497	5 | 6,5
359	509	522	534	546	558	570	582	594	606	618	6 | 7,8
360	630	642	654	666	678	691	703	715	727	739	7 | 9,1
											8 | 10,4
361	751	763	775	787	799	811	823	835	847	859	9 | 11,7
362	871	883	895	907	919	931	943	955	967	979	
363	991	*003	*015	*027	*038	*050	*062	*074	*086	*098	
364	56 110	122	134	146	158	170	182	194	205	217	**12**
365	229	241	253	265	277	289	301	312	324	336	
366	348	360	372	384	396	407	419	431	443	455	1 | 1,2
367	467	478	490	502	514	526	538	549	561	573	2 | 2,4
368	585	597	608	620	632	644	656	667	679	691	3 | 3,6
369	703	714	726	738	750	761	773	785	797	808	4 | 4,8
370	820	832	844	855	867	879	891	902	914	926	5 | 6,0
											6 | 7,2
371	937	949	961	972	984	996	*008	*019	*031	*043	7 | 8,4
372	57 054	066	078	089	101	113	124	136	148	159	8 | 9,6
373	171	183	194	206	217	229	241	252	264	276	9 | 10,8
374	287	299	310	322	334	345	357	368	380	392	
375	403	415	426	438	449	461	473	484	496	507	
376	519	530	542	553	565	576	588	600	611	623	**11**
377	634	646	657	669	680	692	703	715	726	738	
378	749	761	772	784	795	807	818	830	841	852	1 | 1,1
379	864	875	887	898	910	921	933	944	955	967	2 | 2,2
380	978	990	*001	*013	*024	*035	*047	*058	*070	*081	3 | 3,3
											4 | 4,4
381	58 092	104	115	127	138	149	161	172	184	195	5 | 5,5
382	206	218	229	240	252	263	274	286	297	309	6 | 6,6
383	320	331	343	354	365	377	388	399	410	422	7 | 7,7
384	433	444	456	467	478	490	501	512	524	535	8 | 8,8
385	546	557	569	580	591	602	614	625	636	647	9 | 9,9
386	659	670	681	692	704	715	726	737	749	760	
387	771	782	794	805	816	827	838	850	861	872	
388	883	894	906	917	928	939	950	961	973	984	**10**
389	995	*006	*017	*028	*040	*051	*062	*073	*084	*095	
390	59 106	118	129	140	151	162	173	184	195	207	1 | 1,0
											2 | 2,0
391	218	229	240	251	262	273	284	295	306	318	3 | 3,0
392	329	340	351	362	373	384	395	406	417	428	4 | 4,0
393	439	450	461	472	483	494	506	517	528	539	5 | 5,0
394	550	561	572	583	594	605	616	627	638	649	6 | 6,0
395	660	671	682	693	704	715	726	737	748	759	7 | 7,0
396	770	780	791	802	813	824	835	846	857	868	8 | 8,0
397	879	890	901	912	923	934	945	956	966	977	9 | 9,0
398	988	999	*010	*021	*032	*043	*054	*065	*076	*086	
399	60 097	108	119	130	141	152	163	173	184	195	
400	206	217	228	239	249	260	271	282	293	304	
N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.
400	60 206	217	228	239	249	260	271	282	293	304	
401	314	325	336	347	358	369	379	390	401	412	
402	423	433	444	455	466	477	487	498	509	520	
403	531	541	552	563	574	584	595	606	617	627	
404	638	649	660	670	681	692	703	713	724	735	
405	746	756	767	778	788	799	810	821	831	842	**11**
406	853	863	874	885	895	906	917	927	938	949	1 | 1,1
407	959	970	981	991	*002	*013	*023	*034	*045	*055	2 | 2,2
408	61 066	077	087	098	109	119	130	140	151	162	3 | 3,3
409	172	183	194	204	215	225	236	247	257	268	4 | 4,4
410	278	289	300	310	321	331	342	352	363	374	5 | 5,5
411	384	395	405	416	426	437	448	458	469	479	6 | 6,6 7 | 7,7
412	490	500	511	521	532	542	553	563	574	584	8 | 8,8
413	595	606	616	627	637	648	658	609	679	690	9 | 9,9
414	700	711	721	731	742	752	763	773	784	794	
415	805	815	826	836	847	857	868	878	888	899	
416	909	920	930	941	951	962	972	982	993	*003	
417	62 014	024	034	045	055	066	076	086	097	107	
418	118	128	138	149	159	170	180	190	201	211	
419	221	232	242	252	203	273	284	294	304	315	
420	325	335	346	356	366	377	387	397	408	418	**10**
421	428	439	449	459	469	480	490	500	511	521	1 | 1,0
422	531	542	552	562	572	583	593	603	613	624	2 | 2,0
423	634	644	655	665	675	685	696	706	716	726	3 | 3,0
424	737	747	757	767	778	788	798	808	818	829	4 | 4,0
425	839	849	859	870	880	890	900	910	921	931	5 | 5,0
426	941	951	961	972	982	992	*002	*012	*022	*033	6 | 6,0
427	63 043	053	063	073	083	094	104	114	124	134	7 | 7,0
428	144	155	165	175	185	195	205	215	225	236	8 | 8,0
429	246	256	266	276	286	296	306	317	327	337	9 | 9,0
430	347	357	367	377	387	397	407	417	428	438	
431	448	458	468	478	488	498	508	518	528	538	
432	548	558	568	579	589	599	609	619	629	639	
433	649	659	669	679	689	699	709	719	729	739	
434	749	759	769	779	789	799	809	819	829	839	
435	849	859	869	879	889	899	909	919	929	939	**9**
436	949	959	969	979	938	998	*008	*018	*028	*038	1 | 0,9
437	64 048	058	068	078	088	098	108	118	128	137	2 | 1,8
438	147	157	167	177	187	197	207	217	227	237	3 | 2,7
439	246	256	266	276	280	296	306	316	326	335	4 | 3,6
440	345	355	365	375	385	395	404	414	424	434	5 | 4,5 6 | 5,4
441	444	454	464	473	483	493	503	513	523	532	7 | 6,3
442	542	552	562	572	582	591	601	611	621	631	8 | 7,2
443	640	650	600	670	680	689	699	709	719	729	9 | 8,1
444	738	748	758	768	777	787	797	807	816	826	
445	836	846	856	865	875	885	895	904	914	924	
446	933	943	953	963	972	982	992	*002	*011	*021	
447	65 031	040	050	060	070	079	089	099	108	118	
448	128	137	147	157	167	176	186	196	205	215	
449	225	234	244	254	263	273	283	292	302	312	
450	321	331	341	350	360	369	379	389	398	408	
N.	L. 0	1	2	3	4	5	6	7	8	9	P.P.

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.
450	65 321	331	341	350	360	369	379	389	398	408	
451	418	427	437	447	456	466	475	485	495	504	
452	514	523	533	543	552	562	571	581	591	600	
453	610	619	629	639	648	658	667	677	686	696	
454	706	715	725	734	744	753	763	772	782	792	
455	801	811	820	830	839	849	858	868	877	887	
456	896	906	916	925	935	944	954	963	973	982	**10**
457	992	*001	*011	*020	*030	*039	*049	*058	*068	*077	1 1,0
458	66 087	096	106	115	124	134	143	153	162	172	2 2,0
459	181	191	200	210	219	229	238	247	257	266	3 3,0
460	276	285	295	304	314	323	332	342	351	361	4 4,0
											5 5,0
461	370	380	389	398	408	417	427	436	445	455	6 6,0
462	464	474	483	492	502	511	521	530	539	549	7 7,0
463	558	567	577	586	596	605	614	624	633	642	8 8,0
464	652	661	671	680	689	699	708	717	727	736	9 9,0
465	745	755	764	773	783	792	801	811	820	829	
466	839	848	857	867	876	885	894	904	913	922	
467	932	941	950	960	969	978	987	997	*006	*015	
468	67 025	034	043	052	062	071	080	089	099	108	
469	117	127	136	145	154	164	173	182	191	201	
470	210	219	228	237	247	256	265	274	284	293	
											9
471	302	311	321	330	339	348	357	367	376	385	1 0,9
472	394	403	413	422	431	440	449	459	468	477	2 1,8
473	486	495	504	514	523	532	541	550	560	569	3 2,7
474	578	587	596	605	614	624	633	642	651	660	4 3,6
475	669	679	688	697	706	715	724	733	742	752	5 4,5
476	761	770	779	788	797	806	815	825	834	843	6 5,4
477	852	861	870	879	888	897	906	916	925	934	7 6,3
478	943	952	961	970	979	988	997	*006	*015	*024	8 7,2
479	68 034	043	052	061	070	079	088	097	106	115	9 8,1
480	124	133	142	151	160	169	178	187	196	205	
481	215	224	233	242	251	260	269	278	287	296	
482	305	314	323	332	341	350	359	368	377	386	
483	395	404	413	422	431	440	449	458	467	476	
484	485	494	502	511	520	529	538	547	556	565	
485	574	583	592	601	610	619	628	637	646	655	**8**
486	664	673	681	690	699	708	717	726	735	744	1 0,8
487	753	762	771	780	789	797	806	815	824	833	2 1,6
488	842	851	860	869	878	886	895	904	913	922	3 2,4
489	931	940	949	958	966	975	984	993	*002	*011	4 3,2
490	69 020	028	037	046	055	064	073	082	090	099	5 4,0
											6 4,8
491	108	117	126	135	144	152	161	170	179	188	7 5,6
492	197	205	214	223	232	241	249	258	267	276	8 6,4
493	285	294	302	311	320	329	338	346	355	364	9 7,2
494	373	381	390	399	408	417	425	434	443	452	
495	461	469	478	487	496	504	513	522	531	539	
496	548	557	566	574	583	592	601	609	618	627	
497	636	644	653	662	671	679	688	697	705	714	
498	723	732	740	749	758	767	775	784	793	801	
499	810	819	827	836	845	854	862	871	880	888	
500	897	906	914	923	932	940	949	958	966	975	
N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.
500	69, 897	906	914	923	932	940	949	958	966	975	
591	984	992	*001	*010	*018	*027	*036	*044	*053	*062	
502	70, 970	079	088	096	105	114	122	131	140	148	
503	157	165	174	183	191	200	209	217	226	234	
504	243	252	260	269	278	286	295	303	312	321	
505	329	338	346	355	364	372	381	389	398	406	
506	415	424	432	441	449	458	467	475	484	492	
507	501	509	518	526	535	544	552	561	569	578	**9**
508	586	595	603	612	621	629	638	646	655	663	1 | 0,9
509	672	680	689	697	706	714	723	731	740	749	2 | 1,8
510	757	766	774	783	791	800	808	817	825	834	3 | 2,7
											4 | 3,6
511	842	851	859	868	876	885	893	902	910	919	5 | 4,5
512	927	935	944	952	961	969	978	986	995	*003	6 | 5,4
513	71, 012	029	029	037	046	054	063	071	079	088	7 | 6,3
514	096	105	113	122	130	139	147	155	164	172	8 | 7,2
515	181	189	198	206	214	223	231	240	248	257	9 | 8,1
516	265	273	282	290	299	307	315	324	332	341	
517	349	357	366	374	383	391	399	408	416	425	
518	433	441	450	458	466	475	483	492	500	508	
519	517	525	533	542	550	559	567	575	584	592	
520	600	609	617	625	634	642	650	659	667	675	
521	684	692	700	709	717	725	734	742	750	759	**8**
522	767	775	784	792	800	809	817	825	834	842	1 | 0,8
523	850	858	867	875	883	892	900	908	917	925	2 | 1,6
524	933	941	950	958	966	975	983	991	999	*008	3 | 2,4
525	72, 016	024	032	041	049	957	066	074	082	090	4 | 3,2
526	099	107	115	123	132	140	148	156	165	173	5 | 4,0
527	181	189	198	206	214	222	230	239	247	255	6 | 4,8
528	263	272	280	288	296	304	313	321	329	337	7 | 5,6
529	346	354	362	370	378	387	395	403	411	419	8 | 6,4
530	428	436	444	452	460	469	477	485	493	501	9 | 7,2
531	509	518	526	534	542	550	558	567	575	583	
532	591	599	607	616	624	632	640	648	656	665	
533	673	681	689	697	705	713	722	730	738	746	
534	754	762	770	779	787	795	803	811	819	827	
535	835	843	852	860	869	876	884	892	900	908	
536	916	925	933	941	949	957	965	973	981	989	**7**
537	997	*006	*014	*022	*030	*038	*046	*054	*062	*070	1 | 0,7
538	73, 078	086	094	102	111	119	127	135	143	151	2 | 1,4
539	159	167	175	183	191	199	207	215	223	231	3 | 2,1
540	239	247	255	263	272	280	288	296	304	312	4 | 2,8
											5 | 3,5
541	320	328	336	344	352	360	368	376	384	392	6 | 4,2
542	400	408	416	424	432	440	448	456	404	472	7 | 4,9
543	480	488	496	504	512	520	528	536	544	552	8 | 5,6
544	560	568	576	584	592	600	608	616	624	632	9 | 6,3
545	640	648	656	664	672	679	687	695	703	711	
546	719	727	735	743	751	759	767	775	783	791	
547	799	807	815	823	830	838	846	854	862	870	
548	878	886	894	902	910	918	926	933	941	949	
549	957	965	973	981	989	997	*005	*013	*020	*028	
550	74, 036	044	052	060	068	076	084	092	099	107	
N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. o.	1	2	3	4	5	6	7	8	9	P. P.
550	74 036	044	052	060	068	076	084	092	099	107	
551	115	123	131	139	147	155	162	170	178	186	
552	194	202	210	218	225	233	241	249	257	265	
553	273	280	288	296	304	312	320	327	335	343	
554	351	359	367	374	382	390	398	406	414	421	
555	429	437	445	453	461	468	476	484	492	500	
556	507	515	523	531	539	547	554	562	570	578	
557	586	593	601	609	617	624	632	640	648	656	
558	663	671	679	687	695	702	710	718	726	733	
559	741	749	757	764	772	780	788	796	803	811	
560	819	827	834	842	850	858	865	873	881	889	
561	896	904	912	920	927	935	943	950	958	966	8
562	974	981	989	997	*005	*012	*020	*028	*035	*043	1 | 0,8
563	75 051	059	066	074	082	089	097	105	113	120	2 | 1,6
564	128	136	143	151	159	166	174	182	189	197	3 | 2,4
565	205	213	220	228	236	243	251	259	266	274	4 | 3,2
566	282	289	297	305	312	320	328	335	343	351	5 | 4,0
567	358	366	374	381	389	397	404	412	420	427	6 | 4,8
568	435	442	450	458	465	473	481	488	496	504	7 | 5,6
569	511	519	526	534	542	549	557	565	572	580	8 | 6,4
570	587	595	603	610	618	626	633	641	648	656	9 | 7,2
571	664	671	679	686	694	702	709	717	724	732	
572	740	747	755	762	770	778	785	793	800	808	
563	815	823	831	838	846	853	861	868	876	884	
574	891	899	906	914	921	929	937	944	952	959	
575	967	974	982	989	997	*005	*012	*020	*027	*035	
576	76 042	050	057	065	072	080	087	095	103	110	
577	118	125	133	140	148	155	163	170	178	185	
578	193	200	208	215	223	230	238	245	253	260	
579	268	275	283	290	298	305	313	320	328	335	
580	343	350	358	365	373	380	388	395	403	410	7
581	418	425	433	440	448	455	462	470	477	485	1 | 0,7
582	492	500	507	515	522	530	537	545	552	559	2 | 1,4
583	567	574	582	589	597	604	612	619	626	634	3 | 2,1
584	641	649	656	664	671	678	686	693	701	708	4 | 2,8
585	716	723	730	738	745	753	760	768	775	782	5 | 3,5
586	790	797	805	812	819	827	834	842	849	856	6 | 4,2
587	864	871	879	886	893	901	908	916	923	930	7 | 4,9
588	938	945	953	960	967	975	982	989	997	*004	8 | 5,6
589	77 012	019	026	034	041	048	056	063	070	078	9 | 6,3
590	085	093	100	107	115	122	129	137	144	151	
591	159	166	173	181	188	195	203	210	217	225	
592	232	240	247	254	262	269	276	283	291	298	
593	305	313	320	327	335	342	349	357	364	371	
594	379	386	393	401	408	415	422	430	437	444	
595	452	459	466	474	481	488	495	503	510	517	
596	525	532	539	546	554	561	568	576	583	590	
597	597	605	612	619	627	634	641	648	656	663	
598	670	677	685	692	699	706	714	721	728	735	
599	743	750	757	764	772	779	786	793	801	808	
600	815	822	830	837	844	851	859	866	873	880	
N.	L. 0.	1	2	3	4	5	6	7	8	9	P. P.

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.
600	77 815	822	830	837	844	851	859	866	873	880	
601	887	895	902	909	916	924	931	938	945	952	
602	960	967	974	981	988	996	*003	*010	*017	*025	
603	78 032	039	046	053	061	068	075	082	089	097	
604	104	111	118	125	132	140	147	154	161	168	
605	176	183	190	197	204	211	219	226	233	240	
606	247	254	262	269	276	283	290	297	305	312	
607	319	326	333	340	347	355	362	369	376	383	**8**
608	390	398	405	412	419	426	433	440	447	455	1 | 0,8
609	462	469	476	483	490	497	504	512	519	526	2 | 1,6
610	533	540	547	554	561	569	576	583	590	597	3 | 2,4
											4 | 3,2
611	604	611	618	625	633	640	647	654	661	668	5 | 4,0
612	675	682	689	696	704	711	718	725	732	739	6 | 4,8
613	746	753	760	767	774	781	789	796	803	810	7 | 5,6
614	817	824	831	838	845	852	859	866	873	880	8 | 6,4
615	888	895	902	909	916	923	930	937	944	951	9 | 7,2
616	958	965	072	979	986	993	*000	*007	*014	*021	
617	79 029	036	043	050	057	064	071	078	085	092	
618	099	106	113	120	127	134	141	148	155	162	
619	169	176	183	190	197	204	211	218	225	232	
620	239	246	253	260	267	274	281	288	295	302	
											7
621	309	316	323	330	337	344	351	358	360	372	
622	379	386	393	400	407	414	421	428	435	442	1 | 0,7
623	449	456	463	470	477	484	491	498	505	511	2 | 1,4
624	518	525	532	539	546	553	560	567	574	581	3 | 2,1
625	588	595	602	609	616	623	630	637	644	650	4 | 2,8
626	657	664	671	678	685	692	699	706	713	720	5 | 3,5
627	727	734	741	748	754	761	768	775	782	789	6 | 4,2
628	796	803	810	817	824	831	837	844	851	858	7 | 4,9
629	865	872	879	886	893	900	906	913	920	927	8 | 5'6
630	934	941	948	955	962	969	975	982	989	996	9 | 6,3
631	80 003	010	017	024	030	037	044	051	058	065	
632	072	079	085	092	099	106	113	120	127	134	
633	140	147	154	161	168	175	182	188	195	202	
634	209	216	223	229	236	243	250	257	264	271	**6**
635	277	284	291	298	305	312	318	325	332	339	
636	346	353	359	366	373	380	387	393	490	407	1 | 0,6
637	414	421	428	434	441	448	455	462	468	475	2 | 1,2
638	482	489	496	502	509	516	523	530	536	543	3 | 1,8
639	550	557	564	570	577	584	591	598	604	611	4 | 2,4
640	618	625	632	638	645	652	659	665	672	679	5 | 3,0
											6 | 3,6
641	686	693	699	706	713	720	726	733	740	747	7 | 4,2
642	754	760	767	774	781	787	794	801	808	814	8 | 4,8
643	821	828	835	841	848	855	862	868	875	882	9 | 5,4
644	889	895	902	909	916	922	929	936	943	949	
645	956	963	969	976	983	990	996	*003	*010	*017	
646	81 023	030	037	043	050	057	064	070	077	084	
647	090	097	104	111	117	124	131	137	144	151	
648	158	164	171	178	184	191	198	204	211	218	
649	224	231	238	245	251	258	265	271	278	285	
650	291	298	305	311	318	325	331	338	345	351	
N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.
650	81 291	298	305	311	318	325	331	338	345	351	
651	358	365	371	378	385	391	398	405	411	418	
652	425	431	438	445	451	458	465	471	478	485	
653	491	498	505	511	518	525	531	538	544	551	
654	558	564	571	578	584	591	598	604	611	617	
655	624	631	637	644	651	657	664	671	677	684	
656	690	697	704	710	717	723	730	737	743	750	
657	757	763	770	776	783	790	796	803	809	816	
658	823	829	836	842	849	856	862	869	875	882	
658	889	895	902	908	915	921	928	935	941	948	
660	954	961	968	974	981	987	994	*000	*007	*014	
661	82 020	027	033	040	046	053	060	066	073	079	
662	086	092	099	105	112	119	125	132	138	145	**7**
663	151	158	164	171	178	184	191	197	204	210	1 0,7
664	217	223	230	236	243	249	256	263	269	276	2 1,4
665	282	289	295	302	308	315	321	328	334	341	3 2,1
666	347	354	360	367	373	380	387	393	400	406	4 2,8
667	413	419	426	432	439	445	452	458	465	471	5 3,5
668	478	484	491	497	504	510	517	523	530	536	6 4,2
669	543	549	556	562	569	575	582	588	595	601	7 4,9
670	607	614	620	627	633	640	646	653	659	666	8 5,6
671	672	679	685	692	698	705	711	718	724	730	9 6,3
672	737	743	750	756	763	769	776	782	789	795	
673	802	808	814	821	827	834	840	847	853	860	
674	866	872	879	885	892	898	905	911	918	924	
675	930	937	943	950	956	963	969	975	982	988	
676	995	*001	*008	*014	*020	*027	*033	*040	*046	*052	
677	83 059	065	072	078	085	091	097	104	110	117	
678	123	129	136	142	149	155	161	168	174	181	
679	187	193	200	206	213	219	225	232	238	245	
680	251	257	264	270	276	283	289	296	302	308	
681	315	321	327	334	340	347	353	359	366	372	**6**
682	378	385	391	398	404	410	417	423	429	436	1 0,6
683	442	448	455	461	407	474	480	487	493	499	2 1,2
684	506	512	518	525	531	537	544	550	556	563	3 1,8
685	569	575	582	588	594	601	607	613	620	626	4 2,4
686	632	639	645	651	658	664	670	677	683	689	5 3,0
687	696	702	708	715	721	727	734	740	746	753	6 3,6
688	759	765	771	778	784	790	797	803	809	816	7 4,2
689	822	828	835	841	847	853	860	866	872	879	8 4.8
690	885	891	897	904	910	916	923	929	935	942	9 5,4
691	948	954	960	967	973	979	985	992	998	*004	
692	84 011	017	023	029	036	042	048	055	061	067	
693	073	080	086	092	098	105	111	117	123	130	
694	136	142	148	155	161	167	173	180	186	192	
695	198	205	211	217	223	230	236	242	248	255	
696	261	267	273	280	286	292	298	305	311	317	
697	323	330	336	342	348	354	361	367	373	379	
698	386	392	398	404	410	417	423	429	435	442	
699	448	454	460	466	473	479	485	491	497	504	
700	510	516	522	528	535	541	547	553	559	566	
N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.
700	84 510	516	522	528	535	541	547	553	559	566	
701	572	578	584	590	597	603	609	615	621	628	
702	634	640	646	652	658	665	671	677	683	689	
703	696	702	708	714	720	726	733	739	745	751	
704	757	763	770	776	782	788	794	800	807	813	7
705	819	825	831	837	844	850	856	862	868	874	
706	880	887	893	899	905	911	917	924	930	936	1 | 0,7
707	942	948	954	960	967	973	979	985	991	997	2 | 1,4
708	85 003	009	016	022	028	034	040	046	052	058	3 | 2,1
709	065	071	077	083	089	095	101	107	114	120	4 | 2,8
710	126	132	138	144	150	156	163	169	175	181	5 | 3,5 6 | 4,2
711	187	193	199	205	211	217	224	230	236	242	7 | 4,9
712	248	254	260	266	272	278	285	291	297	303	8 | 5,6
713	309	315	321	327	333	339	345	352	358	364	9 | 6,3
714	370	376	382	388	394	400	406	412	418	425	
715	431	437	443	449	455	461	467	473	479	485	
716	491	497	503	509	516	522	528	534	540	546	
717	552	558	564	570	576	582	588	594	600	606	
718	612	618	625	631	637	643	649	655	661	667	
719	673	679	685	691	697	703	709	715	721	727	
720	733	739	745	751	757	763	769	775	781	788	6
721	794	800	806	812	818	824	830	836	842	848	1 | 0,6
722	854	860	866	872	878	884	890	896	902	908	2 | 1,2
723	914	920	926	932	938	944	950	956	962	968	3 | 1,8
724	974	980	986	992	998	*004	*010	*016	*022	*028	4 | 2,4
725	86 034	040	046	052	058	064	070	076	082	088	5 | 3,0
726	094	100	106	112	118	124	130	136	141	147	6 | 3,6
727	153	159	165	171	177	183	189	195	201	207	7 | 4,2
728	213	219	225	231	237	243	249	255	261	267	8 | 4,8
729	273	279	285	291	297	303	308	314	320	326	9 | 5,4
730	332	338	344	350	356	362	368	374	380	386	
731	392	398	404	410	415	421	427	433	439	445	
732	451	457	463	469	475	481	487	493	499	504	
733	510	516	522	528	534	540	546	552	558	564	
734	570	576	581	587	593	599	605	611	617	622	
735	629	635	641	646	652	658	664	670	676	682	
736	688	694	700	705	711	717	723	729	735	741	5
737	747	753	759	764	770	776	782	788	794	800	
738	806	812	817	823	829	835	841	847	853	859	1 | 0,5
739	864	870	876	882	888	894	900	906	911	917	2 | 1,0
740	923	929	935	941	947	953	958	964	970	976	3 | 1,5 4 | 2,0
741	982	988	994	999	*005	*011	*017	*023	*029	*035	5 | 2,5
742	87 040	046	052	058	064	070	075	081	087	093	6 | 3,0
743	099	105	111	116	122	128	134	140	146	151	7 | 3,5
744	157	163	169	175	181	186	192	198	204	210	8 | 4,0
745	216	221	227	233	239	245	251	256	262	268	9 | 4,5
746	274	280	286	291	297	303	309	315	320	326	
747	332	338	344	349	355	361	367	373	379	384	
748	390	396	402	408	413	419	425	431	437	442	
749	448	454	460	466	471	477	483	489	495	500	
750	506	512	518	523	529	535	541	547	552	558	
N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.
750	87 506	512	518	523	529	535	541	547	552	558	
751	564	570	576	581	587	593	599	604	610	616	
752	622	628	633	639	645	651	656	662	668	674	
753	679	685	691	697	703	708	714	720	726	731	
754	737	743	749	754	760	766	772	777	783	789	
755	795	800	806	812	818	823	829	835	841	846	
756	852	858	864	869	875	881	887	892	898	904	
757	910	915	921	927	933	938	944	950	955	961	
758	967	973	978	984	990	996	*001	*007	*013	*018	
759	88 024	030	036	041	047	053	058	064	070	076	
760	081	087	093	098	104	110	116	121	127	133	
761	138	144	150	156	161	167	173	178	184	190	6
762	195	201	207	213	218	224	230	235	241	247	1 | 0,6
763	252	258	264	270	275	281	287	292	298	304	2 | 1,2
764	309	315	321	326	332	338	343	349	355	360	3 | 1,8
765	366	372	377	383	389	395	400	406	412	417	4 | 2,4
766	423	429	434	440	446	451	457	463	468	474	5 | 3,0
767	480	485	491	497	502	508	513	519	525	530	6 | 3,6
768	536	542	547	553	559	564	570	576	581	587	7 | 4,2
769	593	598	604	610	615	621	627	632	638	643	8 | 4,8
770	649	655	660	666	672	677	683	689	694	700	9 | 5'4
771	705	711	717	722	728	734	739	745	750	756	
772	762	767	773	779	784	790	795	801	807	812	
773	818	824	829	835	840	846	852	857	863	868	
774	874	880	885	891	897	902	908	913	919	925	
775	930	936	941	947	953	958	964	969	975	981	
776	986	992	997	*003	*009	*014	*020	*025	*031	*037	
777	89 042	048	053	059	064	070	076	081	087	092	
778	098	104	109	115	120	126	131	137	143	148	
779	154	159	165	170	176	182	187	193	198	204	
780	209	215	221	226	232	237	243	248	254	260	
781	265	271	276	282	287	293	298	304	310	315	5
782	321	326	332	337	343	348	354	360	365	371	1 | 0,5
783	376	382	387	393	398	404	409	415	421	426	2 | 1'0
784	432	437	443	448	454	459	465	470	476	481	3 | 1,5
785	487	492	498	504	509	515	520	526	531	537	4 | 2,0
786	542	548	553	559	564	570	575	581	586	592	5 | 2,5
787	597	603	609	614	620	625	631	636	642	647	6 | 3,0
788	653	658	664	669	675	680	686	691	697	702	7 | 3,5
789	708	713	719	724	730	735	741	746	752	757	8 | 4,0
790	763	768	774	779	785	790	796	801	807	812	9 | 4,5
791	818	823	829	834	840	845	851	856	862	867	
792	873	878	883	889	894	900	905	911	916	922	
793	927	933	938	944	949	955	960	966	971	977	
794	982	988	993	998	*004	*009	*015	*020	*026	*031	
795	90 037	042	048	053	059	064	069	075	080	086	
796	091	097	102	108	113	119	124	129	135	140	
797	146	151	157	162	168	173	179	184	189	195	
798	200	206	211	217	222	227	233	238	244	249	
799	255	260	266	271	276	282	287	293	298	304	
800	309	314	320	325	331	336	342	347	352	358	
N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.
800	90 309	314	320	325	331	336	342	347	352	358	
801	363	369	374	380	385	390	396	401	407	412	
802	417	423	428	434	439	445	450	455	461	466	
803	472	477	482	488	493	499	504	509	515	520	
804	526	531	536	542	547	553	558	563	569	574	
805	580	585	590	596	601	607	612	617	623	628	
806	634	639	644	650	655	660	666	671	677	682	
807	687	693	698	703	709	714	720	725	730	736	
808	741	747	752	757	763	768	773	779	784	789	
809	795	800	806	811	816	822	827	832	838	843	
810	849	854	859	865	870	875	881	886	891	897	
811	902	907	913	918	924	929	934	940	945	950	**6**
812	956	961	966	972	977	982	988	993	998	*004	1 0,6
813	91 009	014	020	025	030	036	041	046	052	057	2 1,2
814	062	068	073	078	084	089	094	100	105	110	3 1,8
815	116	121	126	132	137	142	148	153	158	164	4 2,4
816	169	174	180	185	190	196	201	206	212	217	5 3,0
817	222	228	233	238	243	249	254	259	265	270	6 3,6
818	275	281	286	291	297	302	307	312	318	323	7 4,2
819	328	334	339	344	350	355	360	365	371	376	8 4,8
820	381	387	392	397	403	408	413	418	424	429	9 5,4
821	434	440	445	450	455	461	466	471	477	482	
822	487	402	498	503	508	514	519	524	529	535	
823	540	545	551	556	561	566	572	577	582	587	
824	593	598	603	609	614	619	624	630	635	640	
825	645	651	656	661	666	672	677	682	687	693	
826	698	703	709	714	719	724	730	735	740	745	
827	751	756	761	766	772	777	782	787	793	798	
828	803	808	814	819	824	829	934	840	845	850	
829	855	861	866	871	876	882	887	892	897	903	
830	908	913	918	924	929	934	939	944	950	955	
831	960	965	971	976	981	986	991	997	*002	*007	**5**
832	92 012	018	023	028	033	038	044	049	054	059	1 0,5
833	065	070	075	080	085	091	096	101	106	111	2 1,0
834	117	122	127	132	137	143	148	153	158	163	3 1,5
835	169	174	179	184	189	195	200	205	210	215	4 2,0
836	221	226	231	236	241	247	252	257	262	267	5 2,5
837	273	278	283	288	293	298	304	309	314	319	6 3,0
838	324	330	335	340	345	350	355	361	366	371	7 3,5
839	376	381	387	392	397	402	407	412	418	423	8 4,0
840	428	433	438	443	449	454	459	464	469	474	9 4,5
841	480	485	490	495	500	505	511	516	521	526	
842	531	536	542	547	552	557	562	567	572	578	
843	583	588	593	598	603	609	614	619	624	629	
844	634	639	145	650	655	660	665	670	675	681	
845	686	691	696	701	706	711	716	722	727	732	
846	737	742	747	752	758	763	768	773	778	783	
847	788	793	799	804	809	814	819	824	829	834	
848	840	845	850	855	860	865	870	875	881	886	
849	891	896	901	906	911	916	921	927	932	937	
850	942	947	952	957	962	967	973	978	983	988	
N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.

Table XXXV.—*Containing logarithms of numbers from 1 to 11,000*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.
850	92 942	947	952	957	962	967	973	978	983	988	
851	993	998	*003	*008	*013	*018	*024	*029	*034	*039	
852	93 044	049	054	059	064	069	075	080	085	090	
853	095	100	105	110	115	120	125	131	136	141	
854	146	151	156	161	166	171	176	181	186	192	
855	197	202	207	212	217	222	227	232	237	242	
856	247	252	258	263	268	273	278	283	288	293	
857	298	303	308	313	318	323	328	334	339	344	**6**
858	349	354	359	364	369	374	379	384	389	394	1 0,6
859	399	404	409	414	420	425	430	435	440	445	2 1,2
860	450	455	460	465	470	475	480	485	490	495	3 1,8
											4 2,4
861	500	505	510	515	520	526	531	536	541	546	5 3,0
862	551	556	561	566	571	576	581	586	591	596	6 3,6
863	601	606	611	616	621	626	631	636	641	646	7 4,2
864	651	656	661	666	671	676	682	687	692	697	8 4,8
865	702	707	712	717	722	727	732	737	742	747	9 5,4
866	752	757	762	767	772	777	782	787	792	797	
867	802	807	812	817	822	827	832	837	842	847	
868	852	857	862	867	872	877	882	887	892	897	
869	902	907	912	917	922	927	932	937	942	947	
870	952	957	962	967	972	977	982	987	992	997	
871	94 002	007	012	017	022	027	032	037	042	047	**5**
872	052	057	062	067	072	077	082	086	091	096	1 0,5
873	101	106	111	116	121	126	131	136	141	146	2 1,0
874	151	156	161	166	171	176	181	186	191	196	3 1,5
875	201	206	211	216	221	226	231	236	240	245	4 2,0
876	250	255	260	265	270	275	280	285	290	295	5 2,5
877	300	305	310	315	320	325	330	335	340	345	6 3,0
878	349	354	359	364	369	374	379	384	389	394	7 3,5
879	399	404	409	414	419	424	429	433	438	443	8 4,0
880	448	453	458	463	468	473	478	483	488	493	9 4,5
881	498	503	507	512	517	522	527	532	537	542	
882	547	552	557	562	567	571	576	581	586	591	
883	596	601	606	611	616	621	626	630	635	640	
884	645	650	655	660	665	670	675	680	685	689	
885	694	699	704	709	714	719	724	729	734	738	
886	743	748	753	758	763	768	773	778	783	787	**4**
887	792	797	802	807	812	817	822	827	832	836	1 0,4
888	841	846	851	856	861	866	871	876	880	885	2 0,8
889	890	895	900	905	910	915	919	924	929	934	3 1,2
890	939	944	949	954	959	963	968	973	978	983	4 1,6
											5 2,0
891	988	993	998	*002	*007	*012	*017	*022	*027	*032	6 2,4
892	95 036	041	046	051	056	061	066	071	075	080	7 2,8
893	085	090	095	100	105	109	114	119	124	129	8 3,2
894	134	139	143	148	153	158	163	168	173	177	9 3,6
895	182	187	192	197	202	207	211	216	221	226	
896	231	236	240	245	250	255	260	265	270	274	
897	279	284	289	294	299	303	308	313	318	323	
898	328	332	337	342	347	352	357	361	366	371	
899	376	381	386	390	395	400	405	410	415	419	
900	424	429	434	439	444	448	453	458	463	468	
N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000.*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.
900	95 424	429	434	439	444	448	453	458	463	468	
901	472	477	482	487	492	497	501	506	511	516	
902	521	525	530	535	540	545	550	554	559	564	
903	569	574	578	583	588	593	598	602	607	612	
904	617	622	626	631	636	641	646	650	655	660	
905	665	670	674	679	684	689	694	698	703	708	
906	713	718	722	727	732	737	742	746	751	756	
907	761	766	770	775	780	785	789	794	799	804	
908	809	813	818	823	828	832	837	842	847	852	
909	856	861	866	871	875	880	885	890	895	899	
910	904	909	914	918	923	928	933	938	942	947	
911	952	957	961	966	971	976	980	985	990	995	5
912	999	*004	*009	*014	*019	*023	*028	*033	*038	*042	1 0,5
913	96 047	052	057	061	066	071	076	080	085	090	2 1,0
914	095	099	104	109	114	118	123	128	133	137	3 1,5
915	142	147	152	156	161	166	171	175	180	185	4 2,0
916	190	194	199	204	209	213	218	223	227	232	5 2,5
917	237	242	246	251	256	261	265	270	275	280	6 3,0
918	284	289	294	298	303	308	313	317	322	327	7 3,5
919	332	336	341	346	350	355	360	365	369	374	8 4,0
920	379	384	388	393	398	402	407	412	417	421	9 4,5
921	426	431	435	440	445	450	454	459	464	468	
922	473	478	483	487	492	497	501	506	511	515	
923	520	525	530	534	539	544	548	553	558	562	
924	567	572	577	581	586	591	595	600	605	609	
925	614	619	624	628	633	638	642	647	652	656	
926	661	666	670	675	680	685	689	694	699	703	
927	708	713	717	722	727	731	736	741	745	750	
928	755	759	764	769	774	778	783	788	792	797	
929	802	806	811	816	820	825	830	834	839	844	
930	848	853	858	862	867	872	876	881	886	890	
931	895	900	904	909	914	918	923	928	932	937	4
932	942	946	951	956	960	965	970	974	979	984	1 0,4
933	988	993	997	*002	*007	*011	*016	*021	*025	*030	2 0,8
934	97 035	039	044	049	053	058	063	067	072	077	3 1,2
935	081	086	090	095	100	104	109	114	118	123	4 1,6
936	128	132	137	142	146	151	155	160	165	169	5 2,0
937	174	179	183	188	192	197	202	206	211	216	6 2,4
938	220	225	230	234	239	243	248	253	257	262	7 2,8
939	267	271	276	280	285	290	294	299	304	308	8 3,2
940	313	317	322	327	331	336	340	345	350	354	9 3,6
941	359	364	368	373	377	382	387	391	396	400	
942	405	410	414	419	424	428	433	437	442	447	
943	451	456	460	465	470	474	479	483	488	493	
944	497	502	506	511	516	520	525	529	534	539	
945	543	548	552	557	562	566	571	575	580	585	
946	589	594	598	603	607	612	617	621	626	630	
947	635	640	644	649	653	658	663	667	672	676	
948	681	685	690	695	699	704	708	713	717	722	
949	727	731	736	740	745	749	754	759	763	768	
950	772	777	782	786	791	795	800	804	809	813	
N.	L. 0	1	2	3	4	5	6	7	8	9	P. P.

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000.*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	P.P.
950	97 772	777	782	786	791	795	800	804	809	813	
951	818	823	827	832	836	841	845	850	855	859	
952	864	868	873	877	882	886	891	896	900	905	
953	909	914	918	923	928	932	937	941	946	950	
954	955	959	964	968	973	978	982	987	991	996	
955	98 000	005	009	014	019	023	028	032	037	041	
956	046	050	055	059	064	068	073	078	082	087	
957	091	096	100	105	109	114	118	123	127	132	
958	137	141	146	150	155	159	164	168	173	177	
959	182	186	191	195	200	204	209	214	218	223	
960	227	232	236	241	245	250	254	259	263	268	
961	272	277	281	286	290	295	299	304	308	313	5
962	318	322	327	331	336	340	345	349	354	358	1 0,5
963	363	367	372	376	381	385	390	394	399	403	2 1,0
964	408	412	417	421	426	430	435	439	444	448	3 1,5
965	453	457	462	466	471	475	480	484	489	493	4 2,0
966	498	502	507	511	516	520	525	529	534	538	5 2,5
967	543	547	552	556	561	565	570	574	579	583	6 3,0
968	588	592	597	601	605	610	614	619	623	628	7 3,5
969	632	637	641	646	650	655	659	664	668	673	8 4,0
970	677	682	686	691	795	700	704	709	713	717	9 4,5
971	722	726	731	735	740	744	749	753	758	762	
972	767	771	776	780	784	789	793	798	802	807	
973	811	816	820	825	829	834	838	843	847	851	
974	856	860	865	869	874	878	883	887	892	896	
975	900	905	909	914	918	923	927	932	936	941	
976	945	949	954	958	963	967	972	976	981	985	
977	989	994	998	*003	*007	*012	*016	*021	*025	*029	
978	99 034	038	043	047	052	056	061	065	069	074	
979	078	083	087	092	096	100	105	109	114	118	
980	123	127	131	136	140	145	149	154	158	162	
981	167	171	176	180	185	189	193	198	202	207	4
982	211	216	220	224	229	233	238	242	247	251	1 0,4
983	255	260	264	269	273	277	282	286	291	295	2 0,8
984	300	304	308	313	317	322	326	330	335	339	3 1,2
985	344	348	352	357	361	366	370	374	379	383	4 1,6
986	388	392	396	401	405	410	414	419	423	427	5 2,0
987	432	436	441	445	449	454	458	463	467	471	6 2,4
988	476	480	484	489	493	498	502	506	511	515	7 2,8
989	520	524	528	533	537	542	546	550	555	559	8 3,2
990	564	568	572	577	581	585	590	594	599	603	9 3,6
991	607	612	616	621	625	629	634	638	642	647	
992	651	656	660	664	669	673	677	682	686	691	
993	695	699	704	708	712	717	721	726	730	734	
994	739	743	747	752	756	760	765	769	774	778	
995	782	787	791	795	800	804	808	813	817	822	
996	826	830	835	839	843	848	852	856	861	865	
997	870	874	878	883	887	891	896	900	904	909	
998	913	917	922	926	930	935	939	944	948	952	
999	957	961	965	970	974	978	983	987	991	996	
1000	00 000	004	009	013	017	022	026	030	035	039	
N.	L. 0	1	2	3	4	5	6	7	8	9	P.P.

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000.*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables-]

N.	L. 0	1	2	3	4	5	6	7	8	9	d.
1000	000 0000	0434	0869	1303	1737	2171	2605	3039	3472	3907	434
1001	4341	4775	5208	5642	6076	6510	6943	7377	7810	8244	434
1002	8677	9111	9544	9977	*0411	*0844	*1277	*1710	*2143	*2576	433
1003	001 3009	3442	3875	4308	4741	5174	5607	6039	6472	6905	433
1004	7337	7770	8202	8635	9067	9499	9932	*0364	*0796	*1228	432
1005	002 1661	2093	2525	2957	3389	3821	4253	4685	5116	5548	432
1006	5980	6411	6843	7275	7706	8138	8569	9001	9432	9863	431
1007	003 0295	0726	1157	1588	2019	2451	2882	3313	3744	4174	431
1008	4605	5036	5467	5898	6328	6759	7190	7620	8051	8481	431
1009	8912	9342	9772	*0203	*0633	*1063	*1493	*1924	*2354	*2784	430
1010	004 3214	3644	4074	4504	4933	5363	5793	6223	6652	7082	430
1011	7512	7941	8371	8800	9229	9659	*0088	*0517	*0947	*1376	429
1012	005 1805	2234	2663	3092	3521	3950	4379	4808	5237	5666	429
1013	6094	6523	6952	7380	7809	8238	8666	9094	9523	9951	429
1014	006 0380	0808	1236	1664	2092	2521	2949	3377	3805	4233	428
1015	4660	5088	5516	5944	6372	6799	7227	7655	8082	8510	428
1016	8937	9365	9792	*0219	*0647	*1074	*1501	*1928	*2355	*2782	427
1017	007 3210	3637	4064	4490	4917	5344	5771	6198	6624	7051	427
1018	7478	7904	8331	8757	9184	9610	*0037	*0463	*0889	*1316	426
1019	008 1742	2168	2594	3020	3446	3872	4298	4724	5150	5576	426
1020	6002	6427	6853	7279	7704	8130	8556	8981	9407	9832	426
1021	009 0257	0683	1108	1533	1959	2384	2809	3234	3659	4084	425
1022	4509	4934	5359	5784	6208	6633	7058	7483	7907	8332	425
1023	8756	9181	9605	*0030	*0454	*0878	*1303	*1727	*2151	*2575	424
1024	010 3000	3424	3848	4272	4696	5120	5544	5967	6391	6815	424
1025	7239	7662	8086	8510	8933	9357	9780	*0204	*0627	*1050	424
1026	011 1474	1897	2320	2743	3166	3590	4013	4436	4859	5282	423
1027	5704	6127	6550	6973	7396	7818	8241	8664	9086	9509	423
1028	9931	*0354	*0776	*1198	*1621	*2043	*2465	*2887	*3310	*3732	422
1029	012 4154	4576	4998	5420	5842	6264	6685	7107	7529	7951	422
1030	8372	8794	9215	9637	*0059	*0480	*0901	*1323	*1744	*2165	422
1031	013 2587	3008	3429	3850	4271	4692	5113	5534	5955	6376	421
1032	6797	7218	7639	8059	8480	8901	9321	9742	*0162	*0583	421
1033	014 1003	1424	1844	2264	2685	3105	3525	3945	4365	4785	420
1034	5205	5625	6045	6465	6885	7305	7725	8144	8564	8984	420
1035	9403	9823	*0243	*0662	*1082	*1501	*1920	*2340	*2759	*3178	420
1036	015 3598	4017	4436	4855	5274	5693	6112	6531	6950	7369	419
1037	7788	8206	8625	9044	9462	9881	*0300	*0718	*1137	*1555	419
1038	016 1974	2392	2810	3229	3647	4065	4483	4901	5319	5737	418
1039	6155	6573	6991	7409	7827	8245	8663	9080	9498	9916	418
1040	017 0333	0751	1168	1586	2003	2421	2838	3256	3673	4090	417
1041	4507	4924	5342	5759	6176	6593	7010	7427	7844	8260	417
1042	8677	9094	9511	9927	*0344	*0761	*1177	*1594	*2010	*2427	417
1043	018 2843	3259	3676	4092	4508	4925	5341	5757	6173	6589	416
1044	7005	7421	7837	8253	8669	9084	9500	9916	*0332	*0747	416
1045	019 1163	1578	1994	2410	2825	3240	3656	4071	4486	4902	415
1046	5317	5732	6147	6562	6977	7392	7807	8222	8637	9052	415
1047	9467	9882	*0296	*0711	*1126	*1540	*1955	*2369	*2784	*3198	415
1048	020 3613	4027	4442	4856	5270	5684	6099	6513	6927	7341	414
1049	7755	8169	8583	8997	9411	9824	*0238	*0652	*1066	*1479	414
1050	021 1893	2307	2720	3134	3547	3961	4374	4787	5201	5614	413
N.	L. 0	1	2	3	4	5	6	7	8	9	d.

TABLE XXXV.—*Containing logarithms of numbers from 1 to 11,000.*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

N.	L. 0	1	2	3	4	5	6	7	8	9	d.
1050	021 1893	2307	2720	3134	3547	3961	4374	4787	5201	5614	413
1051	6027	6440	6854	7267	7680	8093	8506	8919	9332	9745	413
1052	022 0157	0570	0983	1396	1808	2221	2634	3046	3459	3871	413
1053	4284	4696	5109	5521	5933	6345	6758	7170	7582	7994	412
1054	8406	8818	9230	9642	*0054	*0466	*0878	*1289	*1701	*2113	412
1055	023 2525	2936	3348	3759	4171	4582	4994	5405	5817	6228	411
1056	6639	7050	7462	7873	8284	8695	9106	9517	9928	*0339	411
1057	024 0750	1161	1572	1982	2393	2804	3214	3625	4036	4446	411
1058	4857	5267	5678	6088	6498	6909	7319	7729	8139	8549	410
1059	8960	9370	9780	*0190	*0600	*1010	*1419	*1829	*2239	*2649	410
1060	025 3059	3468	3878	4288	4697	5107	5516	5926	6335	6744	410
1061	7154	7563	7972	8382	8791	9200	9609	*0018	*0427	*0836	409
1062	026 1245	1654	2063	2472	2881	3289	3698	4107	4515	4924	409
1063	5333	5741	6150	6558	6967	7375	7783	8192	8600	9008	408
1064	9416	9824	*0233	*0641	*1049	*1457	*1865	*2273	*2680	*3088	408
1065	027 3496	3904	4312	4719	5127	5535	5942	6350	6757	7165	408
1066	7572	7979	8387	8794	9201	9609	*0016	*0423	*0830	*1237	407
1067	028 1644	2051	2458	2865	3272	3679	4086	4492	4899	5306	407
1068	5713	6119	6526	6932	7339	7745	8152	8558	8964	9371	406
1069	9777	*0183	*0590	*0996	*1402	*1808	*2214	*2620	*3026	*3432	406
1070	029 3838	4244	4649	5055	5461	5867	6272	6678	7084	7489	406
1071	7895	8300	8706	9111	9516	9922	*0327	*0732	*1138	*1543	405
1072	030 1948	2353	2758	3163	3568	3973	4378	4783	5188	5592	405
1073	5997	6402	6807	7211	7616	8020	8425	8830	9234	9638	405
1074	031 0043	0447	0851	1256	1660	2064	2468	2872	3277	3681	404
1075	4085	4489	4893	5296	5700	6104	6508	6912	7315	7719	404
1076	8123	8526	8930	9333	9737	*0140	*0544	*0947	*1350	*1754	403
1077	032 2157	2560	2963	3367	3770	4173	4576	4979	5382	5785	403
1078	6188	6590	6993	7396	7799	8201	8604	9007	9409	9812	403
1079	033 0214	0617	1019	1422	1824	2226	2629	3031	3433	3835	402
1080	4238	4640	5042	5444	5846	6248	6650	7052	7453	7855	402
1081	8257	8659	9060	9462	9864	*0265	*0667	*1068	*1470	*1871	402
1082	034 2273	2674	3075	3477	3878	4279	4680	5081	5482	5884	401
1083	6285	6686	7087	7487	7888	8289	8690	9091	9491	9892	401
1084	035 0293	0693	1094	1495	1895	2296	2696	3096	3497	3897	400
1085	4297	4698	5098	5498	5898	6298	6698	7098	7498	7898	400
1086	8298	8698	9098	9498	9898	*0297	*0697	*1097	*1496	*1896	400
1087	036 2295	2695	3094	3494	3893	4293	4692	5091	5491	5890	399
1088	6289	6688	7087	7486	7885	8284	8683	9082	9481	9880	399
1089	037 0279	0678	1076	1475	1874	2272	2671	3070	3468	3867	399
1090	4265	4663	5062	5460	5858	6257	6655	7053	7451	7849	398
1091	8248	8646	9044	9442	9839	*0237	*0635	*1033	*1431	*1829	398
1092	038 2226	2624	3022	3419	3817	4214	4612	5009	5407	5804	398
1093	6202	6599	6996	7393	7791	8188	8585	8982	9379	9776	397
1094	039 0173	0570	0967	1364	1761	2158	2554	2951	3348	3745	397
1095	4141	4538	4934	5331	5727	6124	6520	6917	7313	7709	397
1096	8106	8502	8898	9294	9690	*0086	*0482	*0878	*1274	*1670	396
1097	040 2066	2462	2858	3254	3650	4045	4441	4837	5232	5628	396
1098	6023	6419	6814	7210	7605	8001	8396	8791	9187	9582	395
1099	9977	*0372	*0767	*1162	*1557	*1952	*2347	*2742	*3137	*3532	395
1100	041 3927	4322	4716	5111	5506	5900	6295	6690	7084	7479	395
N.	L. 0	1	2	3	4	5	6	7	8	9	d.

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents.*

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

0°

'	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	
0	----------	----------	----------	----------	----------	0.00 000	60
1	6.46 373		6.46 373		3.53 627	0.00 000	59
2	6.76 476	30103	6.76 476	30103	3.23 524	0.00 000	58
3	6.94 085	17609	6.94 085	17609	3.05 915	0.00 000	57
4	7.06 579	12494	7.06 579	12494	2.93 421	0.00 000	56
5	7.16 270	9691	7.16 270	9691	2.83 730	0.00 000	55
6	7.24 188	7918	7.24 188	7918	2.75 812	0.00 000	54
7	7.30 882	6694	7.30 882	6694	2.69 118	0.00 000	53
8	7.36 682	5800	7.36 682	5800	2.63 318	0.00 000	52
9	7.41 797	5115	7.41 797	5115	2.58 203	0.00 000	51
10	7.46 373	4576	7.46 373	4576	2.53 627	0.00 000	50
11	7.50 512	4139	7.50 512	4139	2.49 488	0.00 000	49
12	7.54 291	3779	7.54 291	3779	2.45 709	0.00 000	48
13	7.57 767	3476	7.57 767	3476	2.42 233	0.00 000	47
14	7.60 985	3218	7.60 986	3219	2.39 014	0.00 000	46
15	7.63 982	2997	7.63 982	2996	2.36 018	0.00 000	45
16	7.66 784	2802	7.66 785	2803	2.33 215	0.00 000	44
17	7.69 417	2633	7.69 418	2633	2.30 582	9.99 999	43
18	7.71 900	2483	7.71 900	2482	2.28 100	9.99 999	42
19	7.74 248	2348	7.74 248	2348	2.25 752	9.99 999	41
20	7.76 475	2227	7.76 476	2228	2.23 524	9.99 999	40
21	7.78 594	2119	7.78 595	2119	2.21 405	9.99 999	39
22	7.80 615	2021	7.80 615	2020	2.19 385	9.99 999	38
23	7.82 545	1930	7.82 546	1931	2.17 454	9.99 999	37
24	7.84 393	1848	7,84 394	1848	2.15 606	9.99 999	36
25	7.86 166	1773	7.86 167	1773	2.13 833	9.99 999	35
26	7.87 870	1704	7.87 871	1704	2.12 129	9.99 999	34
27	7.89 509	1639	7.89 510	1639	2.10 490	9.99 999	33
28	7.91 088	1579	7.91 089	1579	2.08 911	9.99 999	32
29	7.92 612	1524	7.92 613	1524	2.07 387	9.99 998	31
30	7.94 084	1472	7.94 086	1473	2.05 914	9.99 998	30
31	7.95 508	1424	7.95 510	1424	2.04 490	9.99 998	29
32	7.96 887	1379	7.96 889	1379	2.03 111	9.99 998	28
33	7.98 223	1336	7.98 225	1336	2.01 775	9.99 998	27
34	7.99 520	1297	7.99 522	1297	2.00 478	9.99 998	26
35	8.00 779	1259	8.00 781	1259	1.99 219	9.99 998	25
36	8.02 002	1223	8.02 004	1223	1.97 996	9.99 998	24
37	8.03 192	1190	8.03 194	1190	1.96 806	9.99 997	23
38	8.04 350	1158	8.04 353	1159	1.95 647	9.99 997	22
39	8.05 478	1128	8.05 481	1128	1.94 519	9.99 997	21
40	8.06 578	1100	8.06 581	1100	1.93 419	9.99 997	20
41	8.07 650	1072	8.07 653	1072	1.92 347	9.99 997	19
42	8.08 696	1046	8.08 700	1047	1.91 300	9.99 997	18
43	8.09 718	1022	8.09 722	1022	1.90 278	9.99 997	17
44	8.10 717	999	8.10 720	998	1.89 280	9.99 996	16
45	8.11 693	976	8.11 696	976	1.88 304	9.99 996	15
46	8.12 647	954	8.12 651	955	1.87 349	9.99 996	14
47	8.13 581	934	8.13 585	934	1.86 415	9.99 996	13
48	8.14 495	914	8.14 500	915	1.85 500	9.99 996	12
49	8.15 391	896	8.15 395	895	1.84 605	9.99 996	11
50	8.16 268	877	8.16 273	878	1.83 727	9.99 995	10
51	8.17 128	860	8.17 133	860	1.82 867	9.99 995	9
52	8.17 971	843	8.17 976	843	1.82 024	9.99 995	8
53	8.18 798	827	8.18 804	828	1.81 196	9.99 995	7
54	8.19 610	812	8.19 616	812	1.80 384	9.99 895	6
55	8.20 407	797	8.20 413	797	1.79 587	9.99 994	5
56	8.21 189	782	8.21 195	782	1.78 805	9.99 994	4
57	8.21 958	769	8.21 964	769	1.78 036	9.99 994	3
58	8.22 713	755	8.22 720	756	1.77 280	9.99 994	2
59	8.23 456	743	8.23 462	742	1.76 538	9.99 994	1
60	8.24 186	730	8.24 192	730	1.75 808	9.99 993	0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	'

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TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents.*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

1°

'	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	
0	8.24 186	717	8.24 192	718	1.75 808	9.99 993	60
1	8.24 903	706	8.24 910	706	1.75 090	9.99 993	59
2	8.25 609	695	8.25 616	696	1.74 384	9.99 993	58
3	8.26 304	684	8.26 312	684	1.73 688	9.99 993	57
4	8.26 988	673	8.26 996	673	1.73 004	9.99 992	56
5	8.27 661	663	8.27 669	663	1.72 331	9.99 992	55
6	8.28 324	653	8.28 332	654	1.71 668	9.99 992	54
7	8.28 977	644	8.28 986	643	1.71 014	9.99 992	53
8	8.29 621	634	8.29 629	634	1.70 371	9.99 992	52
9	8.30 255	624	8.30 263	625	1.69 737	9.99 991	51
10	8.30 879	616	8.30 888	617	1.69 112	9.99 991	**50**
11	8.31 495	608	8.31 505	607	1.68 495	9.99 991	49
12	8.32 103	599	8.32 112	599	1.67 888	9.99 990	48
13	8.32 702	590	8.32 711	591	1.67 289	9.99 990	47
14	8.33 292	583	8.33 302	584	1.66 698	9.99 990	46
15	8.33 875	575	8.33 886	575	1.66 114	9.99 990	45
16	8.34 450	568	8.34 461	568	1.65 539	9.99 989	44
17	8.35 018	560	8.35 029	561	1.64 971	9.99 989	43
18	8.35 578	553	8.35 590	553	1.64 410	9.99 989	42
19	8.36 131	547	8.36 143	546	1.63 857	9.99 989	41
20	8.36 678	539	8.36 689	540	1.63 311	9.99 988	**40**
21	8.37 217	533	8.37 229	533	1.62 771	9.99 988	39
22	8.37 750	526	8.37 762	527	1.62 238	9.99 988	38
23	8.38 276	520	8.38 289	520	1.61 711	9.99 987	37
24	8.38 796	514	8.38 809	514	1.61 191	9.99 987	36
25	8.39 310	508	8.39 323	509	1.60 677	9.99 987	35
26	8.39 818	502	8.39 832	502	1.60 168	9.99 986	34
27	8.40 320	496	8.40 334	496	1.59 666	9.99 986	33
28	8.40 816	491	8.40 830	491	1.59 170	9.99 986	32
29	8.41 307	485	8.41 321	486	1.58 679	9.99 985	31
30	8.41 792	480	8.41 807	480	1.58 193	9.99 985	**30**
31	8.42 272	474	8.42 287	475	1.57 713	9.99 985	29
32	8.42 746	470	8.42 762	470	1.57 238	9.99 984	28
33	8.43 216	464	8.43 232	464	1.56 768	9.99 984	27
34	8.43 680	459	8.43 696	460	1.56 304	9.99 984	26
35	8.44 139	455	8.44 156	455	1.55 844	9.99 983	25
36	8.44 594	450	8.44 611	450	1.55 389	9.99 983	24
37	8.45 044	445	8.45 061	446	1.54 939	9.99 983	23
38	8.45 489	441	8.45 507	441	1.54 493	9.99 982	22
39	8.45 930	436	8.45 948	437	1.54 052	9.99 982	21
40	8.46 366	433	8.46 385	432	1.53 615	9.99 982	**20**
41	8.46 799	427	8.46 817	428	1.53 183	9.99 981	19
42	8.47 226	424	8.47 245	424	1.52 755	9.99 981	18
43	8.47 650	419	8.47 669	420	1.52 331	9.99 981	17
44	8.48 069	416	8.48 089	416	1.51 911	9.99 980	16
45	8.48 485	411	8.48 505	412	1.51 495	9.99 980	15
46	8.48 896	408	8.48 917	408	1.51 083	9.99 979	14
47	8.49 304	404	8.49 325	404	1.50 675	9.99 979	13
48	8.49 708	400	8.49 729	401	1.50 271	9.99 979	12
49	8.50 108	396	8.50 130	397	1.49 870	9.99 978	11
50	8.50 564	393	8.50 527	393	1.49 473	9.99 978	**10**
51	8.50 897	390	8.50 920	390	1.49 080	9.99 977	9
52	8.51 287	386	8.51 310	386	1.48 690	9.99 977	8
53	8.51 673	382	8.51 696	383	1.48 304	9.99 977	7
54	8.52 055	379	8.52 079	380	1.47 921	9.99 976	6
55	8.52 434	376	8.52 459	376	1.47 541	9.99 976	5
56	8.52 810	373	8.52 835	373	1.47 165	9.99 975	4
57	8.53 183	369	8.53 208	370	1.46 792	9.99 975	3
58	8.53 552	367	8.53 578	367	1.46 422	9.99 974	2
59	8.53 919	363	8.53 945	363	1.46 055	9.99 974	1
60	8.54 282		8.54 308		1.45 692	9.99 974	**0**
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	'

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TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents.*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

2°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	
0	8.54 282	360	8.54 308	361	1.45 692	9.99 974	**60**
1	8.54 642	357	8.54 669	358	1.45 331	9.99 973	59
2	8.54 999	355	8.55 027	355	1.44 973	9.99 973	58
3	8.55 354	351	8.55 382	352	1.44 618	9.99 972	57
4	8.55 705	349	8.55 734	349	1.44 266	9.99 972	56
5	8.56 054	346	8.56 083	346	1.43 917	9.99 971	55
6	8.56 400	343	8.56 429	344	1.43 571	9.99 971	54
7	8.56 743	341	8.56 773	341	1.43 227	9.99 970	53
8	8.57 084	337	8.57 114	338	1.42 886	9.99 970	52
9	8.57 421	336	8.57 452	336	1.42 548	9.99 969	51
10	8.57 757	332	8.57 788	333	1.42 212	9.99 969	**50**
11	8.58 089	330	8.58 121	330	1.41 879	9.99 968	49
12	8.58 419	328	8.58 451	328	1.41 549	9.99 968	48
13	8.58 747	325	8.58 779	326	1.41 221	9.99 967	47
14	8.59 072	323	8.59 105	323	1.40 895	9.99 967	46
15	8.59 395	320	8.59 428	321	1.40 572	9.99 967	45
16	8.59 715	318	8.59 749	319	1.40 251	9.99 966	44
17	8.60 033	316	8.60 068	316	1.39 932	9.99 966	43
18	8.60 349	313	8.60 384	314	1.39 616	9.99 965	42
19	8.60 662	311	8.60 698	311	1.39 302	9.99 964	41
20	8.60 973	309	8.61 009	310	1.38 991	9.99 964	**40**
21	8.61 282	307	8.61 319	307	1.38 681	9.99 963	39
22	8.61 589	305	8.61 626	305	1.38 374	9.99 963	38
23	8.61 894	302	8.61 931	303	1.38 069	9.99 962	37
24	8.62 196	301	8.62 234	301	1.37 766	9.99 962	36
25	8.62 497	298	8.62 535	299	1.37 465	9.99 961	35
26	8.62 795	296	8.62 834	297	1.37 166	9.99 961	34
27	8.63 091	294	8.63 131	295	1.36 869	9.99 960	33
28	8.63 385	293	8.63 426	292	1.36 574	9.99 960	32
29	8.63 678	290	8.63 718	291	1.36 282	9.99 959	31
30	8.63 968	288	8.64 009	289	1.35 991	9.99 959	**30**
31	8.64 256	287	8.64 298	287	1.35 702	9.99 958	29
32	8.64 543	284	8.64 585	285	1.35 415	9.99 958	28
33	8.64 827	283	8.64 870	284	1.35 130	9.99 957	27
34	8.65 110	281	8.65 154	281	1.34 846	9.99 956	26
35	8.65 391	279	8.65 435	280	1.34 565	9.99 956	25
36	8.65 670	277	8.65 715	278	1.34 285	9.99 955	24
37	8.65 947	276	8.65 993	276	1.34 007	9.99 955	23
38	8.66 223	274	8.66 269	274	1.33 731	9.99 954	22
39	8.66 497	272	8.66 543	273	1.33 457	9.99 954	21
40	8.66 769	270	8.66 816	271	1.33 184	9.99 953	**20**
41	8.67 039	269	8.67 087	269	1.32 913	9.99 952	19
42	8.67 308	267	8.67 356	268	1.32 644	9.99 952	18
43	8.67 575	266	8.67 624	266	1.32 376	9.99 951	17
44	8.67 841	263	8.67 890	264	1.32 110	9.99 951	16
45	8.68 104	263	8.68 154	263	1.31 846	9.99 950	15
46	8.68 367	260	8.68 417	261	1.31 583	9.99 949	14
47	8.68 627	259	8.68 678	260	1.31 322	9.99 949	13
48	8.68 886	258	8.68 938	258	1.31 062	9.99 948	12
49	8.69 144	256	8.69 196	257	1.30 804	9.99 948	11
50	8.69 400	254	8.69 453	255	1.30 547	9.99 947	**10**
51	8.69 654	253	8.69 708	254	1.30 292	9.99 946	9
52	8.69 907	252	8.69 962	252	1.30 038	9.99 946	8
53	8.70 159	250	8.70 214	251	1.29 786	9.99 945	7
54	8.70 409	249	8.70 465	249	1.29 535	9.99 944	6
55	8.70 658	247	8.70 714	248	1.29 286	9.99 944	5
56	8.70 905	246	8.70 962	246	1.29 038	9.99 943	4
57	8.71 151	244	8.71 208	245	1.28 792	9.99 942	3
58	8.71 395	243	8.71 453	244	1.28 547	9.99 942	2
59	8.71 638	242	8.71 697	243	1.28 303	9.99 941	1
60	8.71 880		8.71 940		1.28 060	9.99 940	0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	′

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TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

3°

′	L. Sin.	d.	L. Tang.	d.c.	L. Cotg.	L. Cos.	
0	8.71 880	240	8.71 940	241	1.28 060	9.99 940	**60**
1	8.72 120	239	8.72 181	239	1.27 819	9.99 940	59
2	8.72 359	238	8.72 420	239	1.27 580	9.99 939	58
3	8.72 597	237	8.72 659	237	1.27 341	9.99 938	57
4	8.72 834	235	8.72 896	236	1.27 104	9.99 938	56
5	8.73 069	234	8.73 132	234	1.26 868	9.99 937	55
6	8.73 303	232	8.73 366	234	1.26 634	9.99 936	54
7	8.73 535	232	8.73 600	232	1.26 400	9.99 936	53
8	8.73 767	230	8.73 832	231	1.26 168	9.99 935	52
9	8.73 997	229	8.74 063	229	1.25 937	9.99 934	51
10	8.74 226	228	8.74 292	229	1.25 708	9.99 934	**50**
11	8.74 454	226	8.74 521	227	1.25 479	9.99 933	49
12	8.74 680	226	8.74 748	226	1.25 252	9.99 932	48
13	8.74 906	224	8.74 974	225	1.25 026	9.99 932	47
14	8.75 130	223	8.75 199	224	1.24 801	9.99 931	46
15	8.75 353	222	8.75 423	222	1.24 577	9.99 930	45
16	8.75 575	220	8.75 645	222	1.24 355	9.99 929	44
17	8.75 795	220	8.75 867	220	1.24 133	9.99 929	43
18	8.76 015	219	8.76 087	219	1.23 913	9.99 928	42
19	8.76 234	217	8.76 306	219	1.23 694	9.99 927	41
20	8.76 451	216	8.76 525	217	1.23 475	9.99 926	**40**
21	8.76 667	216	8.76 742	216	1.23 258	9.99 926	39
22	8.76 883	214	8.76 958	215	1.23 042	9.99 925	38
23	8.77 097	213	8.77 173	214	1.22 827	9.99 924	37
24	8.77 310	212	8.77 387	213	1.22 613	9.99 923	36
25	8.77 522	211	8.77 600	211	1.22 400	9.99 923	35
26	8.77 733	210	8.77 811	211	1.22 189	9.99 922	34
27	8.77 943	209	8.78 022	210	1.21 978	9.99 921	33
28	8.78 152	208	8.78 232	209	1.21 768	9.99 920	32
29	8.78 360	208	8.78 441	208	1.21 559	9.99 920	31
30	8.78 568	206	8.78 649	206	1.21 351	9.99 919	**30**
31	8.78 774	205	8.78 855	206	1.21 145	9.99 918	29
32	8.78 979	204	8.79 061	205	1.20 939	9.99 917	28
33	8.79 183	203	8.79 266	204	1.20 734	9.99 917	27
34	8.79 386	202	8.79 470	203	1.20 530	9.99 916	26
35	8.79 588	201	8.79 673	202	1.20 327	9.99 915	25
36	8.79 789	201	9.79 875	201	1.20 125	9.99 914	24
37	8.79 990	199	8.80 076	201	1.19 924	9.99 913	23
38	8.80 189	199	8.80 277	199	1.19 723	9.99 913	22
39	8.80 388	197	8.80 476	198	1.19 524	9.99 912	21
40	8.80 585	197	8.80 674	198	1.19 326	9.99 911	**20**
41	8.80 782	196	8.80 872	196	1.19 128	9.99 910	19
42	8.80 978	195	8.81 068	196	1.18 932	9.99 909	18
43	8.81 173	194	8.81 264	195	1.18 736	9.99 909	17
44	8.81 367	193	8.81 459	194	1.18 541	9.99 908	16
45	8.81 560	192	8.81 653	193	1.18 347	9.99 907	15
46	8.81 752	192	8.81 846	192	1.18 154	9.99 906	14
47	8.81 944	190	8.82 038	192	1.17 962	9.99 905	13
48	8.82 134	190	8.82 230	190	1.17 770	9.99 904	12
49	8.82 324	189	8.82 420	190	1.17 580	9.99 904	11
50	8.82 513	188	8.82 610	189	1.17 390	9.99 903	**10**
51	8.82 701	187	8.82 799	188	1.17 201	9.99 902	9
52	8.82 888	187	8.82 987	188	1.17 013	9.99 901	8
53	8.83 075	186	8.83 175	186	1.16 825	9.99 900	7
54	8.83 261	185	8.83 363	186	1.16 639	9.99 899	6
55	8.83 446	184	8.83 547	185	1.16 453	9.99 898	5
56	8.83 630	183	8.83 732	184	1.16 268	9.99 898	4
57	8.83 813	183	8.83 916	184	1.16 084	9.99 897	3
58	8.83 996	181	8.84 100	182	1.15 900	9.99 896	2
59	8.84 177	181	8.84 282	182	1.15 718	9.99 895	1
60	8.84 358		8.84 464		1.15 536	9.99 894	0
	L. Cos.	d.	L. Cotg.	d.c.	L. Tang.	L. Sin.	′

P. P.					
	241	**239**	**237**	**235**	**234**
1	4,0	4,0	4,0	3,9	3,9
2	8,0	8,0	7,9	7,8	7,8
3	12,0	12,0	11,8	11,8	11,7
4	16,1	15,9	15,8	15,7	15,6
5	20,1	19,9	19,8	19,6	19,5
6	24,1	23,9	23,7	23,5	23,4
7	28,1	27,9	27,6	27,4	27,3
8	32,1	31,9	31,6	31,3	31,2
9	36,2	35,8	35,6	35,2	35,1
	232	**229**	**227**	**225**	**223**
1	3,9	3,8	3,8	3,8	3,7
2	7,7	7,6	7,6	7,5	7,4
3	11,6	11,4	11,4	11,2	11,2
4	15,5	15,3	15,1	15,0	14,9
5	19,3	19,1	18,9	18,8	18,6
6	23,2	22,9	22,7	22,5	22,3
7	27,1	26,7	26,5	26,2	26,0
8	30,9	30,5	30,3	30,0	29,7
9	34,8	34,4	34,0	33,8	33,4
	222	**220**	**217**	**215**	**213**
1	3,7	3,7	3,6	3,6	3,6
2	7,4	7,3	7,2	7,2	7,1
3	11,1	11,0	10,8	10,8	10,6
4	14,8	14,7	14,5	14,3	14,2
5	18,5	18,3	18,1	17,9	17,8
6	22,2	22,0	21,7	21,5	21,3
7	25,9	25,7	25,3	25,1	24,8
8	29,6	29,3	28,9	28,7	28,4
9	33,3	33,0	32,6	32,2	32,0
	211	**208**	**206**	**203**	**201**
1	3,5	3,5	3,4	3,4	3,4
2	7,0	6,9	6,9	6,8	6,7
3	10,6	10,4	10,3	10,2	10,0
4	14,1	13,9	13,7	13,5	13,4
5	17,6	17,3	17,2	16,9	16,8
6	21,1	20,8	20,6	20,3	20,1
7	24,6	24,3	24,0	23,7	23,4
8	28,1	27,7	27,5	27,1	26,8
9	31,6	31,2	30,9	30,4	30,2
	199	**197**	**195**	**193**	**192**
1	3,3	3,3	3,2	3,2	3,2
2	6,6	6,6	6,5	6,4	6,4
3	10,0	9,8	9,8	9,6	9,6
4	13,3	13,1	13,0	12,9	12,8
5	16,6	16,4	16,2	16,1	16,0
6	19,9	19,7	19,5	19,3	19,2
7	23,2	23,0	22,8	22,5	22,4
8	26,5	26,3	26,0	25,7	25,6
9	29,8	29,6	29,2	29,0	28,8
	189	**187**	**185**	**183**	**181**
1	3,2	3,1	3,1	3,0	3,0
2	6,3	6,2	6,2	6,1	6,0
3	9,4	9,4	9,2	9,2	9,0
4	12,6	12,5	12,3	12,2	12,1
5	15,8	15,6	15,4	15,2	15,1
6	18,9	18,7	18,5	18,3	18,1
7	22,0	21,8	21,6	21,4	21,1
8	25,2	24,9	24,7	24,4	24,1
9	28,4	28,0	27,8	27,4	27,2
P. P.					

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TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

4°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	
0	8.84 358	181	8.84 464	182	1.15 536	9.99 894	60
1	8.84 539	179	8.84 646	180	1.15 354	9.99 893	59
2	8.84 718	179	8.84 826	180	1.15 174	9.99 892	58
3	8.84 897	178	8.85 006	179	1.14 994	9.99 891	57
4	8.85 075	177	8.85 185	178	1.14 815	9.99 891	56
5	8.85 252	177	8.85 363	177	1.14 637	9.99 990	55
6	8.85 429	176	8.85 540	177	1.14 460	9.99 889	54
7	8.85 605	175	8.85 717	176	1.14 283	9.99 888	53
8	8.85 780	175	8.85 893	176	1.14 107	9.99 887	52
9	8.85 955	173	8.86 069	174	1.13 931	9.99 886	51
10	8.86 128	173	8.86 243	174	1.13 757	9.99 885	50
11	8.86 301	173	8.86 417	174	1.13 583	9.99 884	49
12	8.86 474	171	8.86 591	172	1.13 409	9.99 883	48
13	8.86 645	171	8.86 763	172	1.13 237	9.99 882	47
14	8.86 816	171	8.86 935	171	1.13 065	9.99 881	46
15	8.86 987	169	8.87 106	171	1.12 894	9.99 880	45
16	8.87 156	169	8.87 277	170	1.12 723	9.99 879	44
17	8.87 325	169	8.87 447	169	1.12 553	9.99 879	43
18	8.87 494	167	8.87 616	169	1.12 384	9.99 878	42
19	8.87 661	168	8.87 785	168	1.12 215	9.99 877	41
20	8.87 829	166	8.87 953	167	1.12 047	9.99 876	40
21	8.87 995	166	8.88 120	167	1.11 880	9.99 875	39
22	8.88 161	165	8.88 287	166	1.11 713	9.99 874	38
23	8.88 326	164	8.88 453	165	1.11 547	9.99 873	37
24	8.88 490	164	8.88 618	165	1.11 382	9.99 872	36
25	8.88 654	163	8.88 783	165	1.11 217	9.99 871	35
26	8.88 817	163	8.88 948	163	1.11 052	9.99 870	34
27	8.88 980	162	8.89 111	163	1.10 889	9.99 869	33
28	8.89 142	162	8.89 274	163	1.10 726	9.99 868	32
29	8.89 304	160	8.89 437	161	1.10 563	9.99 867	31
30	8.89 464	161	8.89 598	162	1.10 402	9.99 866	30
31	8.89 625	159	8.89 760	160	1.10 240	9.99 865	29
32	8.89 784	159	8.89 920	160	1.10 080	9.99 864	28
33	8.89 943	159	8.90 080	160	1.09 920	9.99 863	27
34	8.90 102	158	8.90 240	159	1.09 760	9.99 862	26
35	8.90 260	157	8.90 399	158	1.09 601	9.99 861	25
36	8.90 417	157	8.90 557	158	1.09 443	9.99 860	24
37	8.90 574	156	8.90 715	157	1.09 285	9.99 859	23
38	8.90 730	155	8.90 872	157	1.09 128	9.99 858	22
39	8.90 885	155	8.91 029	156	1.08 971	9.99 857	21
40	8.91 040	155	8.91 185	155	1.08 815	9.99 856	20
41	8.91 195	154	8.91 340	155	1.08 660	9.99 855	19
42	8.91 349	153	8.91 495	155	1.08 505	9.99 854	18
43	8.91 502	153	8.91 650	153	1.08 350	9.99 853	17
44	8.91 655	152	8.91 803	154	1.08 197	9.99 852	16
45	8.91 807	152	8.91 957	153	1.08 043	9.99 851	15
46	8.91 959	151	8.92 110	152	1.07 890	9.99 850	14
47	8.92 110	151	8.92 262	152	1.07 738	9.99 848	13
48	8.92 261	150	8.92 414	151	1.07 586	9.99 847	12
49	8.92 411	150	8.92 565	151	1.07 435	9.99 846	11
50	8.92 561	149	8.92 716	150	1.07 284	9.99 845	10
51	8.92 710	149	8.92 866	150	1.07 134	9.99 844	9
52	8.92 859	148	8.93 016	149	1.06 984	9.99 843	8
53	8.93 007	147	8.93 165	148	1.06 835	9.99 842	7
54	8.93 154	147	8.93 313	149	1.06 687	9.99 841	6
55	8.93 301	147	8.93 462	147	1.06 538	9.99 840	5
56	8.93 448	146	8.93 609	147	1.06 391	9.99 839	4
57	8.93 594	146	8.93 756	147	1.06 244	9.99 838	3
58	8.93 740	145	8.93 903	146	1.06 097	9.99 837	2
59	8.93 885	145	8.94 049	146	1.05 951	9.99 836	1
60	8.94 030		8.94 195		1.05 805	9.99 834	0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	′

P. P.

	182	181	179	178	177
1	3,0	3,0	3,0	3,0	3,0
2	6,1	6,0	6,0	5,9	5,9
3	9,1	9,0	9,0	8,9	8,8
4	12,1	12,1	11,9	11,9	11,8
5	15,2	15,1	14,9	14,8	14,8
6	18,2	18,1	17,9	17,8	17,7
7	21,2	21,1	20,9	20,8	20,6
8	24,3	24,1	23,9	23,7	23,6
9	27,3	27,2	26,8	26,7	26,6
	176	**175**	**174**	**173**	**172**
1	2,9	2,9	2,9	2,9	2,9
2	5,9	5,8	5,8	5,8	5,7
3	8,8	8,8	8,7	8,6	8,6
4	11,7	11,7	11,6	11,5	11,5
5	14,7	14,6	14,5	14,4	14,3
6	17,6	17,5	17,4	17,3	17,2
7	20,5	20,4	20,3	20,2	20,1
8	23,5	23,3	23,2	23,1	22,9
9	26,4	26,2	26,1	26,0	25,8
	171	**170**	**169**	**168**	**167**
1	2'8	2,8	2,8	2,8	2,8
2	5,7	5,7	5,6	5,6	5,6
3	8,6	8,5	8,4	8,4	8,4
4	11,4	11,3	11,3	11,2	11,1
5	14,2	14,2	14,1	14,0	13,9
6	17,1	17,0	16,9	16,8	16,7
7	20,0	19,8	19,7	19,6	19,5
8	22,8	22,7	22,5	22,4	22,3
9	25,6	52'5	25,4	25,2	25,0
	166	**165**	**164**	**163**	**162**
1	2,8	2,8	2,7	2,7	2,7
2	5,5	5,5	5,5	5,4	5,4
3	8,3	8,2	8,2	8,2	8,1
4	11,1	11,0	10,9	10,9	10,8
5	13,8	13,8	13,7	13,6	13,5
6	16,6	16,5	16,4	16,3	16,2
7	19,4	19,2	19,1	19,0	18,9
8	22,1	22,0	21,9	21,7	21,6
9	24,9	24,8	24,6	24,4	24,3
	161	**160**	**159**	**158**	**157**
1	2,7	2,7	2,6	2,6	2,6
2	5,4	5,3	5,3	5,3	5,2
3	8,0	8,0	8,0	7,9	7,8
4	10,7	10,7	10,6	10,5	10,5
5	13,4	13,3	13,2	13,2	13,1
6	16,1	16,0	15,9	15,8	15,7
7	18,8	18,7	18,6	18,4	18,3
8	21,5	21,3	21,2	21,1	20,9
9	24,2	24,0	23,8	23,7	23,6
	156	**155**	**154**	**153**	**152**
1	2,6	2,6	2,6	2,6	2,5
2	5,2	5,2	5,1	5,1	5,1
3	7,8	7,8	7,7	7,6	7,6
4	10,4	10,3	10,3	10,2	10,1
5	13,0	12,9	12,8	12,8	12,7
6	15,6	15,5	15,4	15,3	15,2
7	18,2	18,1	18'0	17,8	17,7
8	20,8	20,7	20,5	20,4	20,3
9	23,4	23,2	23,1	23,0	22,8

P. P.

85°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

5°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.		P. P.					
0	8.94 030		8.94 195		1.05 805	9.99 834	**60**		**151**	**149**	**148**	**147**	**146**
1	8.94 174	144	8.94 340	145	1.95 660	9.99 833	59	1	2,5	2,5	2,5	2,4	2,4
2	8.94 317	143	8.94 485	145	1.05 515	9.99 832	58	2	5,0	5,0	4,9	4,9	4,9
3	8.94 461	144	8.94 630	145	1.05 370	9.99 831	57	3	7,6	7,4	7,4	7,4	7,3
4	8.94 603	142	8.94 773	143	1.05 227	9.99 830	56	4	10,1	9,9	9,9	9,8	9,7
5	8.94 746	143	8.94 917	144	1.95 083	9.99 829	55	5	12,6	12,4	12,3	12,2	12,2
6	8.94 887	141	8.95 060	143	1.04 940	9.99 828	54	6	15,1	14,9	14,8	14,7	14,6
7	8.95 029	142	8.95 292	142	1.04 798	9.99 827	53	7	17,6	17,4	17,3	17,2	17,0
8	8.95 170	141	8.95 344	142	1.04 656	9.99 825	52	8	20,1	19,9	19,7	19,6	19,5
9	8.95 310	140	8.95 486	142	1.04 514	9.99 824	51	9	22,6	22,4	22,2	22,0	21,9
10	8.95 450	140	8.95 627	141	1.04 373	9.99 823	**50**		**145**	**144**	**143**	**142**	**141**
11	8.95 589	139	8.95 767	140	1.04 233	9.99 822	49	1	2,4	2,4	2,4	2,4	2,4
12	8.95 728	139	8.95 908	141	1.04 092	9.99 821	48	2	4,8	4,8	4,8	4,7	4,7
13	8.95 867	139	8.96 047	139	1.03 953	9.99 820	47	3	7,2	7,2	7,2	7,1	7,0
14	8.96 005	138	8.96 187	140	1.03 813	9.99 819	46	4	9,7	9,6	9,5	9,5	9,4
15	8.96 143	138	8.96 325	138	1.03 675	9.99 817	45	5	12,1	12,0	11,9	11,8	11,8
16	8.96 280	137	8.96 464	139	1.03 536	9.99 816	44	6	14,5	14,4	14,3	14,2	14,1
17	8.96 417	137	8.96 602	138	1.03 398	9.99 815	43	7	16,9	16,8	16,7	16,6	16,4
18	8.96 553	136	8.96 739	137	1.03 261	9.99 814	42	8	19,3	19,2	19,1	18,9	18,8
19	8.96 689	136	8.96 877	138	1.03 123	9.99 813	41	9	21,8	21,6	21,4	21,3	21,2
20	8.96 825	136	8.97 013	136	1.02 987	9.99 812	**40**		**140**	**139**	**138**	**137**	**136**
21	8.96 960	135	8.97 150	137	1.02 850	9.99 810	39	1	2,3	2,3	2,3	2,3	2,3
22	8.97 095	135	8.97 285	135	1.02 715	9.99 809	38	2	4,7	4,6	4,6	4,6	4,5
23	8.97 229	134	8.97 421	136	1.02 579	9.99 808	37	3	7,0	7,0	6,9	6,8	6,8
24	8.97 363	134	8.97 556	135	1.02 444	9.99 807	36	4	9,3	9,2	9,2	9,1	9,1
25	8.97 496	133	8.97 691	135	1.02 309	9.99 806	35	5	11,7	11,6	11,5	11,4	11,3
26	8.97 629	133	8.97 825	134	1.02 175	9.99 804	34	6	14,0	13,9	13,8	13,7	13,6
27	8.97 762	133	8.97 959	134	1.02 041	9.99 803	33	7	16,3	16,2	16,1	16,0	15,9
28	8.97 894	132	8.98 092	133	1.01 908	9.99 802	32	8	18,7	18,5	18,4	18,3	18,1
29	8.98 026	132	8.98 225	133	1.01 775	9.99 801	31	9	21,0	20,8	20,7	20,6	20,4
30	8.98 157	131	8.98 358	133	1.01 642	9.99 800	**30**		**135**	**134**	**133**	**132**	**131**
31	8.98 288	131	8.98 490	132	1.01 510	9.99 798	29	1	2,2	2,2	2,2	2,2	2,2
32	8.98 419	131	8.98 622	132	1.01 378	9.99 797	28	2	4,5	4,5	4,4	4,4	4,4
33	8.98 549	130	8.98 753	131	1.01 247	9.99 796	27	3	6,8	6,7	6,6	6,6	6,6
34	8.98 679	130	8.98 884	131	1.01 116	9.99 795	26	4	9,0	8,9	8,9	8,8	8,7
35	8.98 808	129	8.99 015	131	1.00 985	9.99 793	25	5	11,2	11,2	11,1	11,0	10,9
36	8.98 937	129	8.99 145	130	1.00 855	9.99 792	24	6	13,5	13,4	13,3	13,2	13,1
37	8.99 066	129	8.99 275	130	1.00 725	9.99 791	23	7	15,8	15,6	15,5	15,4	15,3
38	8.99 194	128	8.99 405	130	1.00 595	9.99 790	23	8	18,0	17,9	17,7	17,6	17,5
39	8.99 322	128	8.99 534	129	1.00 466	9.99 788	21	9	20,2	20,1	20,0	19,8	19,6
40	8.99 450	128	8.99 662	128	1.00 338	9.99 787	**20**		**130**	**129**	**128**	**127**	**126**
41	8.99 577	127	8.99 791	129	1.00 209	9.99 786	19	1	2,2	2,2	2,1	2,1	2,1
42	8.99 704	127	8.99 919	128	1.00 081	9.99 785	18	2	4,3	4,3	4,3	4,2	4,2
43	8.99 830	126	9.00 046	127	0.99 954	9.99 783	17	3	6,5	6,4	6,4	6,4	6,3
44	8.99 956	126	9.00 174	128	0.99 826	9.99 782	16	4	8,7	8,6	8,5	8,5	8,4
45	9.00 082	126	9.00 301	127	0.99 699	9.99 781	15	5	10,8	10,8	10,7	10,6	10,5
46	9.00 207	125	9.00 427	126	0.99 573	9.99 780	14	6	13,0	12,9	12,8	12,7	12,6
47	9.00 332	125	9.00 553	126	0.99 447	9.99 778	13	7	15,2	15,0	14,9	14,8	14,7
48	9.00 456	124	9.00 679	126	0.99 321	9.99 777	12	8	17,3	17,2	17,1	16,9	16,8
49	9.00 581	125	9.00 805	126	0.99 195	9.99 776	11	9	19,5	19,4	19,2	19,0	18,9
50	9.00 704	123	9.09 930	125	0.99 070	9.99 775	**10**		**125**	**124**	**123**	**122**	**121**
51	9.00 828	124	9.01 055	125	0.98 945	9.99 773	9	1	2,1	2,1	2,0	2,0	2,0
52	9.00 951	123	9.01 179	124	0.98 821	9.99 772	8	2	4,2	4,1	4,1	4,1	4,0
53	9.01 074	123	9.01 303	124	0.98 697	9.99 771	7	3	6,2	6,2	6,2	6,1	6,0
54	9.01 196	122	9.01 427	124	0.98 573	9.99 769	6	4	8,3	8,3	8,2	8,1	8,1
55	9.01 318	122	9.01 550	123	0.98 450	9.99 768	5	5	10,4	10,3	10,2	10,2	10,1
56	9.01 440	122	9.01 673	123	0.98 327	9.99 767	4	6	12,5	12,4	12,3	12,2	12,1
57	9.01 561	121	9.01 796	123	0.98 204	9.99 765	3	7	14,6	14,5	14,4	14,2	14,1
58	9.01 682	121	9.01 918	122	0.98 682	9.99 764	2	8	16,7	16,5	16,4	16,3	16,1
59	9.01 803	121	9.02 040	122	0.97 960	9.99 763	1	9	18,8	18,6	18,4	18,3	18,2
60	9.01 923	120	9.02 162	122	0.97 838	9.99 761	0						
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	′	P. P.					

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TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

6°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	
0	9.01 923		9.02 162		0.97 838	9.99 761	**60**
1	9.02 043	120	9.02 283	121	0.97 717	9.99 760	59
2	9.02 163	120	9.02 404	121	0.97 596	9.99 759	58
3	9.02 283	120	9.02 525	121	0.97 475	9.99 757	57
4	9.02 402	119	9.02 645	120	0.97 355	9.99 756	56
5	9.02 520	118	9.02 766	121	0.97 234	9.99 755	55
6	9.02 639	119	9.02 885	119	0.97 115	9.99 753	54
7	9.02 757	118	9.03 005	120	0.96 995	9.99 752	53
8	9.02 874	117	9.03 124	119	0.96 876	9.99 751	52
9	9.02 992	118	9.03 242	118	0.96 758	9.99 749	51
10	9.03 109	117	9.03 361	119	0.96 639	9.99 748	**50**
11	9.03 226	117	9.03 479	118	0.96 521	9.99 747	49
12	9.03 342	116	9.03 597	118	0.96 403	9.99 745	48
13	9.03 458	116	9.03 714	117	0.96 286	9.99 744	47
14	9.03 574	116	9.03 832	118	0.96 168	9.99 742	46
15	9.03 690	116	9.03 948	116	0.96 052	9.99 741	45
16	9.03 805	115	9.04 065	117	0.95 935	9.99 740	44
17	9.03 920	115	9.04 181	116	0.95 819	9.99 738	43
18	9.04 034	114	9.04 297	116	0.95 703	9.99 737	42
19	9.04 149	115	9.04 413	116	0.95 587	9.99 736	41
20	9.04 262	113	9.04 528	115	0.95 472	9.99 734	**40**
21	9.04 376	114	9.04 643	115	0.95 357	9.99 733	39
22	9.04 490	114	9.04 758	115	0.95 242	9.99 731	38
23	9.04 603	113	9.04 873	115	0.95 127	9.99 730	37
24	9.04 715	112	9.04 987	114	0.95 013	9.99 728	36
25	9.04 828	113	9.05 101	114	0.94 899	9.99 727	35
26	9.04 940	112	9.05 214	113	0.94 786	9.99 726	34
27	9.05 052	112	9.05 328	114	0.94 672	9.99 724	33
28	9.05 164	112	9.05 441	113	0.94 559	9.99 723	32
29	9.05 275	111	9.05 553	112	0.94 447	9.99 721	31
30	9.05 386	111	9.05 666	113	0.94 334	9.99 720	**30**
31	9.05 497	111	9.05 778	112	0.94 222	9.99 718	29
32	9.05 607	110	9.05 890	112	0.94 110	9.99 717	28
33	9.05 717	110	9.06 002	112	0.93 998	9.99 716	27
34	9.05 827	110	9.06 113	111	0.93 887	9.99 714	26
35	9.05 937	110	9.06 224	111	0.93 776	9.99 713	25
36	9.06 046	109	9.06 335	111	0.93 665	9.99 711	24
37	9.06 155	109	9.06 445	110	0.93 555	9.99 710	23
38	9.06 264	109	9.06 556	111	0.93 444	9.99 708	22
39	9.06 372	108	9.06 666	110	0.93 334	9.99 707	21
40	9.06 481	109	9.06 775	109	0.93 225	9.99 705	**20**
41	9.06 589	108	9.06 885	110	0.93 115	9.99 704	19
42	9.06 696	107	9.06 994	109	0.93 006	9.99 702	18
43	9.06 804	108	9.07 103	109	0.92 897	9.99 701	17
44	9.06 911	107	9.07 211	108	0.92 789	9.99 699	16
45	9.07 018	107	9.07 320	109	0.92 680	9.99 698	15
46	9.07 124	106	9.07 428	108	0.92 572	9.99 696	14
47	9.07 231	107	9.07 536	108	0.92 464	9.99 695	13
48	9.07 337	106	9.07 643	107	0.92 357	9.99 693	12
49	9.07 442	105	9.07 751	108	0.92 249	9.99 692	11
50	9.07 548	106	9.07 858	107	0.92 142	9.99 690	**10**
51	9.07 653	105	9.07 964	106	0.92 036	9.99 689	9
52	9.07 758	105	9.08 071	107	0.91 929	9.99 687	8
53	9.07 863	105	9.08 177	106	0.91 823	9.99 686	7
54	9.07 968	105	9.08 283	106	0.91 717	9.99 684	6
55	9.08 072	104	9.08 389	106	0.91 611	9.99 683	5
56	9.08 176	104	9.08 495	106	0.91 505	9.99 681	4
57	9.08 280	104	9.08 600	105	0.91 400	9.99 680	3
58	9.08 383	103	9.08 705	105	0.91 295	9.99 678	2
59	9.08 486	103	9.08 810	105	0.91 190	9.99 677	1
60	9.08 589	103	9.08 914	104	0.91 086	9.99 675	**0**
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	′

P. P.

	121	**120**	**119**	**118**
1	2,0	2,0	2,0	2,0
2	4,0	4,0	4,0	3,9
3	6,0	6,0	6,0	5,9
4	8,1	8,0	7,9	7,9
5	10,1	10,0	9,9	9,8
6	12,1	12,0	11,9	11,8
7	14,1	14,0	13,9	13,8
8	16,1	16,0	15,9	15,7
9	18,2	18,0	17,8	17,7
10	20,2	20,0	19,8	19,7
20	40,3	40,0	39,7	39,3
30	60,5	60,0	59,5	59,0
40	80,7	80,0	79,3	78,7
50	100,8	100,0	99,2	98,3

	117	**116**	**115**	**114**
1	2,0	1,9	1,9	1,9
2	3,9	3,9	3,8	3,8
3	5,8	5,8	5,8	5,7
4	7,8	7,7	7,7	7,6
5	9,8	9,7	9,6	9,5
6	11,7	11,6	11,5	11,4
7	13,6	13,5	13,4	13,3
8	15,6	15,5	15,3	15,2
9	17,6	17,4	17,2	17,1
10	19,5	19,3	19,2	19,0
20	39,0	38,7	38,3	38,0
30	58,5	58,0	57,5	57,0
40	78,0	77,3	76,7	76,0
50	97,5	96,7	95,8	95,0

	113	**112**	**111**	**110**
1	1,9	1,9	1,8	1,8
2	3,8	3,7	3,7	3,7
3	5,6	5,6	5,6	5,5
4	7,5	7,5	7,4	7,3
5	9,4	9,3	9,2	9,2
6	11,3	11,2	11,1	11,0
7	13,2	13,1	13,0	12,8
8	15,1	14,9	14,8	14,7
9	17,0	16,8	16,6	16,5
10	18,8	18,7	18,5	18,3
20	37,7	37,3	37,0	36,7
30	56,5	56,0	55,5	55,0
40	75,3	74,7	74,0	73,3
50	94,2	93,3	92,5	91,7

	109	**108**	**107**	**106**
1	1,8	1,8	1,8	1,8
2	3,6	3,6	3,6	3,5
3	5,4	5,4	5,4	5,3
4	7,3	7,2	7,1	7,1
5	9,1	9,0	8,9	8,8
6	10,9	10,8	10,7	10,6
7	12,7	12,6	12,5	12,4
8	14,5	14,4	14,3	14,1
9	16,4	16,2	16,0	15,9
10	18,2	18,0	17,8	17,7
20	36,3	36,0	35,7	35,3
30	54,5	54,0	53,5	53,0
40	72,7	72,0	71,3	70,7
50	90,8	90,0	89,2	88,3

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TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

7°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	
0	9.08 589	103	9.08 914	105	0.91 086	9.99 675	**60**
1	9.08 692	103	9.09 019	104	0.90 981	9.99 674	59
2	9.08 795	102	9.09 123	104	0.90 877	9.99 672	58
3	9.08 897	102	9.09 227	103	0.90 773	9.99 670	57
4	9.08 999	102	9.09 330	104	0.90 670	9.99 669	56
5	9.09 101	101	9.09 434	103	0.90 566	9.99 667	55
6	9.09 202	102	9.09 537	103	0.90 463	9.99 666	54
7	9.09 304	101	9.09 640	102	0.90 360	9.99 664	53
8	9.09 405	101	9.09 742	103	0.90 258	9.99 663	52
9	9.09 506	100	9.09 845	102	0.90 155	9.99 661	51
10	9.09 606	101	9.09 947	102	0.90 053	9.99 659	**50**
11	9.09 707	100	9.10 049	101	0.89 951	9.99 658	39
12	9.09 807	100	9.10 150	102	0.89 850	9.99 656	48
13	9.09 907	99	9.10 252	101	0.89 748	9.99 655	47
14	9.10 006	100	9.10 353	101	0.89 647	9.99 653	46
15	9.10 106	99	9.10 454	101	0.89 546	9.99 651	45
16	9.10 205	99	9.10 555	101	0.89 445	9.99 650	44
17	9.10 304	98	9.10 656	100	0.89 344	9.99 648	43
18	9.10 402	99	9.10 756	100	0.89 244	9.99 647	42
19	9.10 501	98	9.10 856	100	0.89 144	9.99 645	41
20	9.10 599	98	9.10 956	100	0.89 044	9.99 643	**40**
21	9.10 697	98	9.11 056	99	0.88 944	9.99 642	39
22	9.10 795	98	9.11 155	99	0.88 845	9.99 640	38
23	9.10 893	97	9.11 254	99	0.88 746	9.99 638	37
24	9.10 990	97	9.11 353	99	0.88 647	9.99 637	36
25	9.11 087	97	9.11 452	99	0.88 548	9.99 635	35
26	9.11 184	97	9.11 551	98	0.88 449	9.99 633	34
27	9.11 281	96	9.11 649	98	0.88 351	9.99 632	33
28	9.11 377	97	9.11 747	98	0.88 253	9.99 630	32
29	9.11 474	96	9.11 845	98	0.88 155	9.99 629	31
30	9.11 570	96	9.11 943	97	0.88 057	9.99 627	**30**
31	9.11 666	95	9.12 040	98	0.87 960	9.99 625	29
32	9.11 761	96	9.12 138	97	0.87 862	9.99 624	28
33	9.11 857	95	9.12 235	97	0.87 765	9.99 622	27
34	9.11 952	95	9.12 332	96	0.87 668	9.99 620	26
35	9.12 047	95	9.12 428	97	0.87 572	9.99 618	25
36	9.12 142	94	9.12 525	96	0.87 475	9.99 617	24
37	9.12 236	95	9.12 621	96	0.87 379	9.99 615	23
38	9.12 331	94	9.12 717	96	0.87 283	9.99 613	22
39	9.12 425	94	9.12 813	96	0.87 187	9.99 612	21
40	9.12 519	93	9.12 909	95	0.87 091	9.99 610	**20**
41	9.12 612	94	9.13 004	95	0.86 996	9.99 608	19
42	9.12 706	93	9.13 099	95	0.86 901	9.99 607	18
43	9.12 799	93	9.13 194	95	0.86 806	9.99 605	17
44	9.12 892	93	9.13 289	95	0.86 711	9.99 603	16
45	9.12 985	93	9.13 384	94	0.86 616	9.99 601	15
46	9.13 078	93	9.13 478	95	0.86 522	9.99 600	14
47	9.13 171	92	9.13 573	94	0.86 427	9.99 598	13
48	9.13 263	92	9.13 667	94	0.86 333	9.99 596	12
49	9.13 355	92	9.13 761	93	0.86 239	9.99 595	11
50	9.13 447	92	9.13 854	94	0.86 146	9.99 593	**10**
51	9.13 539	91	9.13 948	93	0.86 052	9.99 591	9
52	9.13 630	92	9.14 041	93	0.85 959	9.99 589	8
53	9.13 722	91	9.14 134	93	0.85 866	9.99 588	7
54	9.13 813	91	9.14 227	93	0.85 773	9.99 586	6
55	9.13 904	90	9.14 320	92	0.85 680	9.99 584	5
56	9.13 994	91	9.14 412	92	0.85 588	9.99 582	4
57	9.14 085	90	9.14 504	93	0.85 496	9.99 581	3
58	9.14 175	91	9.14 597	91	0.85 403	9.99 579	2
59	9.14 266	90	9.14 688	92	0.85 312	9.99 577	1
60	9.14 356		9.14 780		0.85 220	9.99 575	**0**
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	′

P. P.

	105	**104**	**103**	**102**
1	1,8	1,7	1,7	1,7
2	3,5	3,5	3,4	3,4
3	5,2	5,2	5,2	5,1
4	7,0	6,9	6,9	6,8
5	8,8	8,7	8,6	8,5
6	10,5	10,4	10,3	10,2
7	12,2	12,1	12,0	11,9
8	14,0	13,9	13,7	13,6
9	15,8	15,6	15,4	15,3
10	17,5	17,3	17,2	17,0
20	35,0	34,7	34,3	34,0
30	52,5	52,0	51,5	51,0
40	70,0	69,3	68,7	68,0
50	87,5	86,7	85,8	85,0
	101	**100**	**99**	**98**
1	1,7	1,7	1,6	1,6
2	3,4	3,3	3,3	3,3
3	5,0	5,0	5,0	4,9
4	6,7	6,7	6,6	6,5
5	8,4	8,3	8,2	8,2
6	10,1	10,0	9,9	9,8
7	11,8	11,7	11,6	11,4
8	13,5	13,3	13,2	13,1
9	15,2	15,0	14,8	14,7
10	16,8	16,7	16,5	16,3
20	33,7	33,3	33,0	32,7
30	50,5	50,0	49,5	49,0
40	67,3	66,7	66,0	65,3
50	84,2	83,3	82,5	81,7
	97	**96**	**95**	**94**
1	1,6	1,6	1,6	1,6
2	3,2	3,2	3,2	3,1
3	4,8	4,8	4,8	4,7
4	6,5	6,4	6,3	6,3
5	8,1	8,0	7,9	7,8
6	9,7	9,6	9,5	9,4
7	11,3	11,2	11,1	11,0
8	12,9	12,8	12,7	12,5
9	14,6	14,4	14,2	14,1
10	16,2	16,0	15,8	15,7
20	32,3	32,0	31,7	31,3
30	48,5	48,0	47,5	47,0
40	64,7	64,0	63,3	62,7
50	80,8	80,0	79,2	78,3
	93	**92**	**91**	**90**
1	1,6	1,5	1,5	1,5
2	3,1	3,1	3,0	3,0
3	4,6	4,6	4,6	4,5
4	6,2	6,1	6,1	6,0
5	7,8	7,7	7,6	7,5
6	9,3	9,2	9,1	9,0
7	10,8	10,7	10,6	10,5
8	12,4	12,3	12,1	12,0
9	14,0	13,8	13,6	13,5
10	15,5	15,3	15,2	15,0
20	31,0	30,7	30,3	30,0
30	46,5	46,0	45,5	45,0
40	62,0	61,3	60,7	60,0
50	77,5	76,7	75,8	75,0

P. P.

82°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

8°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	
0	9.14 356	89	9.14 780	92	0.85 220	9.99 575	**60**
1	9.14 445	90	9.14 872	91	0.85 128	9.99 574	59
2	9.14 535	89	9.14 963	91	0.85 037	9.99 572	58
3	9.14 624	90	9.15 054	91	0.84 946	9.99 570	57
4	9.14 714	89	9.15 145	91	0.84 855	9.99 568	56
5	9.14 803	88	9.15 236	91	0.84 764	9.99 566	55
6	9.14 891	89	9.15 327	90	0.84 673	9.99 565	54
7	9.14 980	89	9.15 417	91	0.84 583	9.99 563	53
8	9.15 069	88	9.15 508	90	0.84 492	9.99 561	52
9	9.15 157	88	9.15 598	90	0.84 402	9.99 559	51
10	9.15 245	88	9.15 688	89	0.84 312	9.99 557	**50**
11	9.15 333	88	9.15 777	90	0.84 223	9.99 556	49
12	9.15 421	87	9.15 867	89	0.84 133	9.99 554	48
13	9.15 508	88	9.15 956	90	0.84 044	9.99 552	47
14	9.15 596	87	9.16 046	89	0.83 954	9.99 550	46
15	9.15 683	87	9.16 135	89	0.83 865	9.99 548	45
16	9.15 770	87	9.16 224	88	0.83 776	9.99 546	44
17	9.15 857	87	9.16 312	89	0.83 688	9.99 545	43
18	9.15 944	86	9.16 401	88	0.83 599	9.99 543	42
19	9.16 030	86	9.16 489	88	0.83 511	9.99 541	41
20	9.16 116	87	9.16 577	88	0.83 423	9.99 539	**40**
21	9.16 203	86	9.16 665	88	0.83 335	9.99 537	39
22	9.16 289	85	9.16 753	88	0.83 247	9.99 535	38
23	9.16 374	86	9.16 841	87	0.83 159	9.99 533	37
24	9.16 460	85	9.16 928	88	0.83 072	9.99 532	36
25	9.16 545	86	9.17 016	87	0.82 984	9.99 530	35
26	9.16 631	85	9.17 103	87	0.82 897	9.99 528	34
27	9.16 716	85	9.17 190	87	0.82 810	9.99 526	33
28	9.16 801	85	9.17 277	86	0.82 723	9.99 524	32
29	9.16 886	84	9.17 363	87	0.82 637	9.99 522	31
30	9.16 970	85	9.17 450	86	0.82 550	9.99 520	**30**
31	9.17 055	84	9.17 536	86	0.82 464	9.99 518	29
32	9.17 139	84	9.17 622	86	0.82 378	9.99 517	28
33	9.17 223	84	9.17 708	86	0.82 292	9.99 515	27
34	9.17 307	84	9.17 794	86	0.82 206	9.99 513	26
35	6.17 391	83	9.17 880	85	0.82 120	9.99 511	25
36	9.17 474	84	9.17 965	86	0.82 035	9.99 509	24
37	9.17 558	83	9.18 051	85	0.81 949	9.99 507	23
38	9.17 641	83	9.18 136	85	0.81 864	9.99 505	22
39	9.17 724	83	9.18 221	85	0.81 779	9.99 503	21
40	9.17 807	83	9.18 306	85	0.81 694	9.99 501	**20**
41	9.17 890	83	9.18 391	84	0.81 609	9.99 499	19
42	9.17 973	82	9.18 475	85	0.81 525	9.99 497	18
43	9.18 055	82	9.18 560	84	0.81 440	9.99 495	17
44	9.18 137	83	9.18 644	84	0.81 356	9.99 494	16
45	9.18 220	82	9.18 728	84	0.81 272	9.99 492	15
46	9.18 302	81	9.18 812	84	0.81 188	9.99 490	14
47	9.18 383	82	9.18 896	83	0.81 104	9.99 488	13
48	9.18 465	82	9.18 979	84	0.81 021	9.99 486	12
49	9.18 547	81	9.19 063	83	0.80 937	9.99 484	11
50	9.18 628	81	9.19 146	83	0.80 854	9.99 482	**10**
51	9.18 709	81	9.19 229	83	0.80 771	9.99 480	9
52	9.18 790	81	9.19 312	83	0.80 688	9.99 478	8
53	9.18 871	81	9.19 395	83	0.80 605	9.99 476	7
54	9.18 952	81	9.19 478	83	0.80 522	9.99 474	6
55	9.19 033	80	9.19 561	82	0.80 439	9.99 472	5
56	9.19 113	80	9.19 643	82	0.80 357	9.99 470	4
57	9.19 193	80	9.19 725	82	0.80 275	9.99 468	3
58	9.19 273	80	9.19 807	82	0.80 193	9.99 466	2
59	9.19 353	80	9.19 889	82	0.80 111	9.99 464	1
60	9.19 433		9.19 971		0.80 029	9.99 462	**0**
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	′

	P. P.		
	92	**91**	**90**
1	1,5	1,5	1,5
2	3,1	3,0	3,0
3	4,6	4,6	4,5
4	6,1	6,1	6,0
5	7,7	7,6	7,5
6	9,2	9,1	9,0
7	10,7	10,6	10,5
8	12,3	12,1	12,0
9	13,8	13,6	13,5
10	15,3	15,2	15,0
20	30,7	30,3	30,0
30	46,0	45,5	45,0
40	61,3	60,7	60,0
50	76,7	75,8	75,0
	89	**88**	**87**
1	1,5	1,5	1,4
2	3,0	2,9	2,9
3	4,4	4,4	4,4
4	5,9	5,9	5,8
5	7,4	7,3	7,2
6	8,9	8,8	8,7
7	10,4	10,3	10,2
8	11,9	11,7	11,6
9	13,4	13,2	13,0
10	14,8	14,7	14,5
20	29,7	29,3	29,0
30	44,5	44,0	43,5
40	59,3	58,7	58,0
50	74,2	73,3	72,5
	86	**85**	**84**
1	1,4	1,4	1,4
2	2,9	2,8	2,8
3	4,3	4,2	4,2
4	5,7	5,7	5,6
5	7,2	7,1	7,0
6	8,6	8,5	8,4
7	10,0	9,9	9,8
8	11,5	11,3	11,2
9	12,9	12,8	12,6
10	14,3	14,2	14,0
20	28,7	28,3	28,0
30	43,0	42,5	42,0
40	57,3	56,7	56,0
50	71,7	70,8	70,0
	83	**82**	**81**
1	1,4	1,4	1,4
2	2,8	2,7	2,7
3	4,2	4,1	4,0
4	5,5	5,5	5,4
5	6,9	6,8	6,8
6	8,3	8,2	8,1
7	9,7	9,6	9,4
8	11,1	10,9	10,8
9	12,4	12,3	12,2
10	13,8	13,7	13,5
20	27,7	27,3	27,0
30	41,5	41,0	40,5
40	55,3	54,7	54,0
50	69,2	68,3	67,5
	P. P.		

81°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

9°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	
0	9.19 433	80	9.19 971	82	0.80 029	9.99 462	60
1	9.19 513	79	9.20 053	81	0.79 947	9.99 460	59
2	9.19 592	80	9.20 134	82	0.79 866	9.99 458	58
3	9.19 672	79	9.20 216	81	0.79 784	9.99 456	57
4	9.19 751	79	9.20 297	81	0.79 703	9.99 454	76
5	9.19 830	79	9.20 378	81	0.79 622	9.99 452	55
6	9.19 909	79	9.20 459	81	0.79 541	9.99 450	54
7	9.19 988	79	9.20 540	81	0.79 460	9.99 448	53
8	9.20 067	78	9.20 621	80	0.79 379	9.99 446	52
9	9.20 145	78	9.20 701	81	0.79 299	9.99 444	51
10	9.20 223	79	9.20 782	80	0.79 218	9.99 442	50
11	9.20 302	78	9.20 862	80	0.79 138	9.99 440	49
12	9.20 380	78	9.20 942	80	0.79 058	9.99 438	48
13	9.20 458	77	9.21 022	80	0.78 978	9.99 436	47
14	9.20 535	78	9.21 102	80	0.78 898	9.99 434	46
15	9.20 613	78	9.21 182	79	0.78 818	9.99 432	45
16	9.20 691	77	9.21 261	80	0.78 739	9.99 429	44
17	9.20 768	77	9.21 341	79	0.78 659	9.99 427	43
18	9.20 845	77	9.21 420	79	0.78 580	9.99 425	42
19	9.20 922	77	9.21 499	79	0.78 501	9.99 423	41
20	9.20 999	77	9.21 578	79	0.78 422	9.99 421	40
21	9.21 076	77	9.21 657	79	0.78 343	9.99 419	39
22	9.21 153	76	9.21 736	78	0.78 264	9.99 417	38
23	9.21 229	77	9.21 814	79	0.78 186	9.99 415	37
24	9.21 306	76	9.21 893	78	0.78 107	9.99 413	36
25	9.21 382	76	9.21 971	78	0.78 029	9.99 411	35
26	9.21 458	76	9.22 049	78	0.77 951	9.99 409	34
27	9.21 534	76	9.22 127	78	0.77 873	9.99 407	33
28	9.21 610	75	9.22 205	78	0.77 795	9.99 404	32
29	9.21 685	76	9.22 283	78	0.77 717	9.99 402	31
30	9.21 761	75	9.22 361	77	0.77 639	9.99 400	30
31	9.21 836	76	9.22 438	78	0.77 562	9.99 398	29
32	9.21 912	75	9.22 516	77	0.77 484	9.99 396	28
33	9.21 987	75	9.22 593	77	0.77 407	9.99 394	27
34	9.22 062	75	9.22 670	77	0.77 330	9.99 392	26
35	9.22 137	74	9.22 747	77	0.77 253	9.99 390	25
36	9.22 211	75	9.22 824	77	0.77 176	9.99 388	24
37	9.22 286	75	9.22 901	76	0.77 099	9.99 385	23
38	9.22 361	74	9.22 977	77	0.77 023	9.99 383	22
39	9.22 435	74	9.23 054	76	0.76 946	9.99 381	21
40	9.22 509	74	9.23 130	76	0.76 870	9.99 379	20
41	9.22 583	74	9.23 206	77	0.76 794	9.99 377	19
42	9.22 657	74	9.23 283	76	0.76 717	9.99 375	18
43	9.22 731	74	9.23 359	76	0.76 641	9.99 372	17
44	9.22 805	73	9.23 435	75	0.76 565	9.99 370	16
45	9.22 878	74	9.23 510	76	0.76 490	9.99 368	15
46	9.22 952	73	6.23 586	75	0.76 414	9.99 366	14
47	9.23 025	73	9.23 661	76	0.76 339	9.99 364	13
48	9.23 098	73	9.23 737	75	0.76 263	9.99 362	12
49	9.23 171	73	9.23 812	75	0.76 188	9.99 359	11
50	9.23 244	73	9.23 887	75	0.76 113	9.99 357	10
51	9.23 317	73	9.23 962	75	0.76 038	9.99 355	9
52	9.23 390	72	9.24 037	75	0.75 963	9.99 353	8
53	9.23 462	73	9.24 112	74	0.75 888	9.99 351	7
54	9.23 535	72	9.24 186	75	0.75 814	9.99 348	6
55	9.23 607	72	9.24 261	74	0.75 739	9.99 346	5
56	9.23 679	73	9.24 335	75	0.75 665	9.99 344	4
57	9.23 752	71	9.24 410	74	0.75 590	9.99 342	3
58	9.23 823	72	9.24 484	74	0.75 516	9.99 340	2
59	9.23 895	72	9.24 558	74	0.75 442	9.99 337	1
60	9.23 967		9.24 632		0.75 368	9.99 335	0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	′

P. P.

	80	79	78	77
1	1,3	1,3	1,3	1,3
2	2,7	2,6	2,6	2,6
3	4,0	4,0	3,9	3,8
4	5,3	5,3	5,2	5,1
5	6,7	6,6	6,5	6,4
6	8,0	7,9	7,8	7,7
7	9,3	9,2	9,1	9,0
8	10,7	10,5	10,4	10,3
9	12,0	11,8	11,7	11,6
10	13,3	13,2	13,0	12,8
20	26,7	26,3	26,0	25,7
30	40,0	39,5	39,0	38,5
40	53,3	52,7	52,0	51,3
50	66,7	65,8	65,0	64,2

	76	75	74	73
1	1,3	1,2	1,2	1,2
2	2,5	2,5	2,5	2,4
3	3,8	3,8	3,7	3,6
4	5,1	5,0	4,9	4,9
5	6,3	6,2	6,2	6,1
6	7,6	7,5	7,4	7,3
7	8,9	8,8	8,6	8,5
8	10,1	10,0	9,9	9,7
9	11,4	11,2	11,1	11,0
10	12,7	12,5	12,3	12,2
20	25,3	25,0	24,7	24,3
30	38,0	37,5	37,0	36,5
40	50,7	50,0	49,3	48,7
50	63,3	62,5	61,7	60,8

	72	71	3	2
1	1,2	1,2	0,0	0,0
2	2,4	2,4	0,1	0,1
3	3,6	3,6	0,2	0,1
4	4,8	4,7	0,2	0,1
5	6,0	5,9	0,2	0,2
6	7,2	7,1	0,3	0,2
7	8,4	8,3	0,4	0,2
8	9,6	9,5	0,4	0,3
9	10,8	10,6	0,4	0,3
10	12,0	11,8	0,5	0,3
20	24,0	23,7	1,0	0,7
30	36,0	35,5	1,5	1,0
40	48,0	47,3	2,0	1,3
50	60,0	59,2	2,5	1,7

	$\frac{3}{79}$	$\frac{3}{78}$	$\frac{3}{77}$
0	13,2	13,0	12,8
1	39,5	39,0	38,5
2	65,8	65,0	64,2
3			

	$\frac{3}{76}$	$\frac{3}{75}$	$\frac{3}{74}$
0	12,7	12,5	12,3
1	38,0	37,5	37,0
2	63,3	62,5	61,7
3			

P. P.

80°

TABLE XXXVI.—*Logaritnmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

10°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.23 967		9.24 632		0.75 368	9.99 335		60
1	9.24 039	72	9.24 706	74	0.75 294	9.99 333	2	59
2	9.24 110	71	9.24 779	73	0.75 221	9.99 331	2	58
3	9.24 181	71	9.24 853	74	0.75 147	9.99 328	3	57
4	9.24 253	72	9.24 926	73	0.75 074	9.99 326	2	56
5	9.24 324	71	9.25 900	74	0.75 000	9.99 324	2	55
6	9.24 395	71	9.25 073	73	0.74 927	9.99 322	2	54
7	9.24 466	71	9.25 146	73	0.74 854	9.99 319	3	53
8	9.24 536	70	9.25 219	73	0.74 781	9.99 317	2	52
9	9.24 697	71	9.25 292	73	0.74 708	9.99 315	2	51
10	9.24 677	70	9.25 365	73	0.74 635	9.99 313	2	50
11	9.24 748	71	9.25 437	72	0.74 563	9.99 310	3	49
12	9.24 818	70	9.25 510	73	0.74 490	9.99 308	2	48
13	9.24 888	70	9.25 582	72	0.74 418	9.99 306	2	47
14	9.24 958	70	9.25 655	73	0.74 345	9.99 304	2	46
15	9.25 028	70	9.25 727	72	0.74 273	9.99 301	3	45
16	9.25 098	70	9.25 799	72	0.74 201	9.99 299	2	44
17	9.25 168	70	9.25 871	72	0.74 129	9.99 297	2	43
18	9.25 237	69	9.25 943	72	0.74 057	9.99 294	3	42
19	9.25 307	70	9.26 015	72	0.73 985	9.99 292	2	41
20	9.25 376	69	9.26 086	71	0.73 914	9.99 290	2	40
21	9.25 445	69	9.26 158	72	0.73 842	9.99 288	2	39
22	9.25 514	69	9.26 229	71	0.73 771	9.99 285	3	38
23	9.25 583	69	9.26 301	72	0.73 699	9.99 283	2	37
24	9.25 652	69	9.26 372	71	0.73 628	9.99 281	2	36
25	9.25 721	69	9.26 443	71	0.73 557	9.99 278	3	35
26	9.25 790	69	9.26 514	71	0.73 486	9.99 276	2	34
27	9.25 858	68	9.26 585	71	0.73 415	9.99 274	2	33
28	9.25 927	69	9.26 655	70	0.73 345	9.99 271	3	32
29	9.25 995	68	9.26 726	71	0 73 274	9.99 269	2	31
30	9.26 063	68	9.26 797	71	0.73 203	9.99 267	2	30
31	9.26 131	68	9.26 867	70	0.73 133	9.99 264	3	29
32	9.26 199	68	9.26 937	70	0.73 063	9.99 262	2	28
33	9.26 267	68	9.27 008	71	0.72 992	9.99 260	2	27
34	9.26 335	68	9.27 078	70	0.72 922	9.99 257	3	26
35	9.26 403	68	9.27 148	70	0.72 852	9.99 255	2	25
36	9.26 470	67	9.27 218	70	0.72 782	9.99 252	3	24
37	9.26 538	68	9.27 288	70	0.72 712	9.99 250	2	23
38	9.26 605	67	9.27 357	69	0.72 643	9.99 248	2	22
39	9.26 672	67	9.27 427	70	0.72 573	9.99 245	3	21
40	9.26 739	67	9.27 496	69	0.72 504	9.99 243	2	20
41	9.26 806	67	9.27 566	70	0.72 434	9.99 241	2	19
42	9.26 873	67	9.27 635	69	0.72 365	9.99 238	3	18
43	9.26 940	67	9.27 704	69	0.72 296	9.99 236	2	17
44	9.27 207	67	9.27 773	69	0.72 227	9.99 233	3	16
45	9.27 073	66	9.27 842	69	0.72 158	9.99 231	2	15
46	9.27 140	67	9.27 911	69	0.72 089	9.99 229	2	14
47	9.27 206	66	9.27 980	69	0.72 020	9.99 226	3	13
48	9.27 273	67	9.28 049	69	0.71 951	9.99 224	2	12
49	9.27 339	66	9.28 117	68	0.71 883	9.99 221	3	11
50	9.27 405	66	9.28 186	69	0.71 814	9.99 219	2	10
51	9.27 471	66	9.28 254	68	0.71 746	9.99 217	2	9
52	9.27 537	66	9.28 323	69	0.71 677	9.99 214	3	8
53	9.27 602	65	9.28 391	68	0.71 609	9.99 212	2	7
54	9.27 668	66	9.28 459	68	0.71 541	9.99 209	3	6
55	9.27 734	66	9.28 527	68	0.71 473	9.99 207	2	5
56	9.27 799	65	9.28 595	68	0.71 405	9.99 204	3	4
57	9.27 864	65	9.28 662	67	0.71 338	9.99 202	2	3
58	9.27 930	66	9.28 730	68	0.71 270	9.99 200	2	2
59	9.27 995	65	9.28 798	68	0.71 202	9.99 197	3	1
60	9.28 060	65	9.28 865	67	0.71 135	9.99 195	2	0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	74	73	72
1	1,2	1,2	1,2
2	2,5	2,4	2,4
3	3,7	3,6	3,6
4	4,9	4,9	4,8
5	6,2	6,1	6,0
6	7,4	7,3	7,2
7	8,6	8,5	8,4
8	9,9	9,7	9,6
9	11,1	11,0	10,8
10	12,3	12,2	12,0
20	24,7	24,3	24,0
30	37,0	36,5	36,0
40	49,3	48,7	48,0
50	61,7	60,8	60,0

	71	70	69
1	1,2	1,2	1,2
2	2,4	2,3	2,3
3	3,6	3,5	3,4
4	4,7	4,7	4,6
5	5,9	5,8	5,8
6	7,1	7,0	6,9
7	8,3	8,2	8,0
8	9,5	9,3	9,2
9	10,6	10,5	10,4
10	11,8	11,7	11,5
20	23,7	23,3	33,0
30	35,5	35,0	34,5
40	47,3	46,7	46,0
50	59,2	58,3	57,5

	68	67	66
1	1,1	1,1	1,1
2	2,3	2,2	2,2
3	3,4	3,4	3,3
4	4,5	4,5	4,4
5	5,7	5,6	5,5
6	6,8	6,7	6,6
7	7,9	7,8	7,7
8	9,1	8,9	8,8
9	10,2	10,0	9,9
10	11,3	11,2	11,0
20	22,7	22,3	22,0
30	34,0	33,5	33,0
40	45,3	44,7	44,0
50	56,7	55,8	55,0

	$\frac{3}{74}$	$\frac{3}{73}$	$\frac{3}{72}$
0 1	12,3	12,2	12,0
1 2	37,0	36,5	36,0
2 3	61,7	60,8	60,0

	$\frac{3}{71}$	$\frac{3}{70}$	$\frac{3}{69}$	$\frac{3}{68}$
0 1	11,8	11,7	11,5	11,3
1 2	35,5	35,0	34,5	34,0
2 3	59,2	58,3	57,5	56,7

P. P.

79°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

11°

'	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9. 28 060		9. 28 865		0. 71 135	9. 99 195		60
1	9. 28 125	65	9. 28 933	68	0. 71 067	9. 99 192	3	59
2	9. 28 190	65	9. 29 000	67	0. 71 000	9. 99 190	2	58
3	9. 28 254	64	9. 29 067	67	0. 70 933	9. 99 187	3	57
4	9. 28 319	65	9. 29 134	67	0, 70 866	9. 99 185	2	56
5	9. 28 384	65	9. 29 201	67	0. 70 799	9. 99 182	3	55
6	9. 28 448	64	9. 29 268	67	0. 70 732	9. 99 180	2	54
7	9. 28 512	64	9. 29 335	67	0. 70 665	9. 99 177	3	53
8	9. 28 577	65	9. 29 402	67	0. 70 598	9. 99 175	2	52
9	9. 28 641	64	9. 29 468	66	0. 70 532	9. 99 172	3	51
10	9 28 705	64	9. 29 535	67	0. 70 465	9. 99 170	2	50
11	9. 28 769	64	9. 29 601	66	0. 70 399	9. 99 167	3	49
12	9. 28 833	64	9. 29 668	67	0. 70 332	9. 99 165	2	48
13	9. 28 896	63	9. 29 734	66	0. 70 266	9. 99 162	3	47
14	9. 28 960	64	9. 29 800	66	0. 70 200	9. 99 160	2	46
15	9. 29 024	64	9. 29 866	66	0. 70 134	9. 99 157	3	45
16	9. 29 087	63	9. 39 932	66	0. 70 068	9. 99 155	2	44
17	9. 29 150	63	9. 29 998	66	0. 70 002	9. 99 152	3	43
18	9. 29 214	64	9. 30 064	66	0. 69 936	9. 99 150	2	42
19	9. 29 277	63	9. 30 130	66	0. 69 870	9. 99 147	3	41
20	9. 29 340	63	9. 30 195	65	0. 69 805	9. 99 145	2	40
21	9. 29 403	63	9. 30 261	66	0. 69 739	9. 99 142	3	39
22	9. 29 466	63	9. 30 326	65	0. 69 674	9. 99 140	2	38
23	9. 29 529	63	9. 30 391	65	0. 69 609	9. 99 137	3	37
24	9. 29 591	63	9. 30 457	66	0. 69 543	9. 99 135	2	36
25	9. 29 654	62	9. 30 522	65	0. 69 478	9. 99 132	3	35
26	9. 29 716	62	9. 30 587	65	0. 69 413	9. 99 130	2	34
27	9. 29 779	63	9. 30 652	65	0. 69 348	9. 99 127	3	33
28	9. 29 841	62	9. 30 717	65	0. 69 283	9. 99 124	3	32
29	9. 29 903	62	9. 30 782	65	0. 69 218	9. 99 122	2	31
30	9. 29 966	63	9. 30 846	64	0. 69 154	9. 99 119	3	30
31	9. 30 028	62	9. 30 911	65	0. 69 089	9. 99 117	2	29
32	9. 30 090	62	9. 30 975	64	0. 69 025	9. 99 114	3	28
33	9. 39 151	61	9. 31 040	65	0. 68 960	9. 99 112	2	27
34	9. 30 213	62	9. 31 104	64	0. 68 896	9. 99 109	3	26
35	9. 30 275	62	9. 31 168	64	0. 68 832	9. 99 106	3	25
36	9. 30 336	61	9. 31 233	65	0. 68 767	9. 99 104	2	24
37	9. 30 398	62	9. 31 297	64	0. 68 703	9. 99 101	3	23
38	9. 30 459	61	9. 31 361	64	0. 68 639	9. 99 099	2	22
39	9. 30 521	62	9. 31 425	64	0. 68 575	9. 99 096	3	21
40	9. 30 582	61	9. 31 489	64	0. 68 511	9. 99 093	3	20
41	9. 39 643	61	9. 31 552	63	0. 68 448	9. 99 091	2	19
42	9. 30 704	61	9. 31 616	64	0. 68 384	9. 99 088	3	18
43	9. 30 765	61	9. 31 679	63	0. 68 321	9. 99 086	2	17
44	9. 30 826	61	9. 31 743	64	0. 68 257	9. 99 083	3	16
45	9. 30 887	61	9. 31 806	63	0. 68 194	9. 99 080	3	15
46	9. 30 947	60	9. 31 870	64	0. 68 130	9. 99 078	2	14
47	9. 31 008	61	9. 31 933	63	0. 68 067	9. 99 075	3	13
48	9. 31 068	60	9. 31 996	63	0. 68 004	9. 99 072	3	12
49	9. 31 129	61	9. 32 059	63	0. 67 941	9. 99 070	2	11
50	9. 31 189	60	9. 32 122	63	0. 67 878	9. 99 067	3	10
51	9. 31 250	61	9. 32 185	63	0. 67 815	9. 99 064	3	9
52	9. 31 310	60	9. 32 248	63	0. 67 752	9. 99 062	2	8
53	9. 31 370	60	9. 32 311	63	0. 67 689	9. 99 059	3	7
54	9. 31 430	60	9. 32 373	62	0. 67 627	9. 99 056	3	6
55	9. 31 490	60	9. 32 436	63	0. 67 564	9. 99 054	2	5
56	9. 31 549	59	9. 32 498	62	0. 67 502	9. 99 051	3	4
57	9. 31 609	60	9. 32 561	63	0. 67 439	9. 99 048	3	3
58	9. 31 669	60	9. 32 623	62	0. 67 377	9. 99 046	2	2
59	9. 31 728	59	9. 32 685	62	0. 67 315	9. 99 043	3	1
60	9. 31 788	60	9. 32 747	62	0. 67 253	9. 99 040	3	0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	'

P. P.

	65	64	63
1	1,1	1,1	1,0
2	2,2	2,1	2,1
3	3,2	3,2	3,2
4	4,3	4,3	4,2
5	5,4	5,3	5,2
6	6,5	6,4	6,3
7	7,6	7,5	7,4
8	8,7	8,5	8,4
9	9,8	9,6	9,4
10	10,8	10,7	10,5
20	21,7	21,3	21,0
30	32,5	32,0	31,5
40	43,3	42,7	42,0
50	54,2	53,3	52,5

	62	61	60
1	1,0	1,0	1,0
2	2,1	2,0	2,0
3	3,1	3,0	3,0
4	4,1	4,1	4,0
5	5,2	5,1	5,0
6	6,2	6,1	6,0
7	7,2	7,1	7,0
8	8,3	8,1	8,0
9	9,3	9,2	9,0
10	10,3	10,2	10,0
20	20,7	20,3	20,0
30	31,0	30,5	30,0
40	41,3	40,7	40,0
50	51,7	50,8	50,0

	59	3	2
1	1,0	0,0	0,0
2	2,0	0,1	0,1
3	3,0	0,2	0,1
4	3,9	0,2	0,1
5	4,8	0,2	0,2
6	5,9	0,3	0,2
7	6,9	0,4	0,2
8	7,9	0,4	0,3
9	8,8	0,4	0,3
10	9,8	0,5	0,3
20	19,7	1,0	0,7
30	29,5	1,5	1,0
40	39,3	2,0	1,3
50	49,2	2,5	1,7

	3	3	3
	67	66	65
0	11,2	11,0	10,8
1	33,5	33,0	32,5
2	55,8	55,0	54,2
3			

	3	3	3
	64	63	62
0	10,7	10,5	10,3
1	32,0	31,5	31,0
2	53,3	52,5	51,7
3			

P. P.

78°

Table XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

12°

'	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.31 788		9.32 747		0.67 253	9.99 040		**60**
1	9.31 847	59	9.32 810	63	0.67 190	9.99 038	2	59
2	9.31 907	60	9.32 872	62	0.67 128	9.99 035	3	58
3	9.31 966	59	9.32 933	61	0.67 067	9.99 032	3	57
4	9.32 025	59	9.32 995	62	0.67 005	9.99 030	2	56
5	9.32 084	59	9.33 057	62	0.66 943	9.99 027	3	55
6	9.32 143	59	9.33 119	62	0.66 881	9.99 024	3	54
7	9.32 202	59	9.33 180	61	0.66 820	9.99 022	2	53
8	9.32 261	59	9.33 242	62	0.66 758	9.99 019	3	52
9	9.32 319	58	9.33 303	61	0.66 697	9.99 016	3	51
10	9.32 378	59	9.33 365	62	0.66 635	9.99 013	3	**50**
11	9.32 437	59	9.33 426	61	0.66 574	9.99 011	2	49
12	9.32 495	58	9.33 487	61	0.66 513	9.99 008	3	48
13	9.32 553	58	9.33 548	61	0.66 452	9.99 005	3	47
14	9.32 612	59	9.33 609	61	0.66 391	9.99 002	3	46
15	9.32 670	58	9.33 670	61	0.66 330	9.99 000	2	45
16	9.32 728	58	9.33 731	61	0.66 269	9.98 997	3	44
17	9.32 786	58	9.33 792	61	0.66 208	9.98 994	3	43
18	9.32 844	58	9.33 853	61	0.66 147	9.98 991	3	42
19	9.32 902	58	9.33 913	60	0.66 087	9.98 989	2	41
20	9.32 960	58	9.33 974	61	0.66 026	9.98 986	3	**40**
21	9.33 018	58	9.34 034	60	0.65 966	9.98 983	3	39
22	9.33 075	57	9.34 095	61	0.65 905	9.98 980	3	38
23	9.33 133	58	9.34 155	60	0.65 845	9.98 978	2	37
24	9.33 190	57	9.34 215	60	0.65 785	9.98 975	3	36
25	9.33 248	58	9.34 276	61	0.65 724	9.98 972	3	35
26	9.33 305	57	9.34 336	60	0.65 664	9.98 969	3	34
27	9.33 362	57	9.34 396	60	0.65 604	9.98 967	2	33
28	9.33 420	58	9.34 456	60	0.65 544	9.98 964	3	32
29	9.33 477	57	9.34 516	60	0.65 484	9.98 961	3	31
30	9.33 534	57	9.34 576	60	0.65 424	9.98 958	3	**30**
31	9.33 591	57	9.34 635	59	0.65 365	9.98 955	3	29
32	9.33 647	56	9.34 695	60	0.65 305	9.98 953	2	28
33	9.33 704	57	9.34 755	60	0.65 245	9.98 950	3	27
34	9.33 761	57	9.34 814	59	0.65 186	9.98 947	3	26
35	9.33 818	57	9.34 874	60	0.65 126	9.98 944	3	25
36	9.33 874	56	9.34 933	59	0.65 067	9.98 941	3	24
37	9.33 931	57	9.34 992	59	0.65 008	9.98 938	3	23
38	9.33 987	56	9.35 051	59	0.64 949	9.98 936	2	22
39	9.34 043	56	9.35 111	60	0.64 889	9.98 933	3	21
40	9.34 100	57	9.35 170	59	0.64 830	9.98 930	3	**20**
41	9.34 156	56	9.35 229	59	0.64 771	9.98 927	3	19
42	9.34 212	56	9.35 288	59	0.64 712	9.98 924	3	18
43	9.34 268	56	9.35 347	59	0.64 653	9.98 921	3	17
44	9.34 324	56	9.35 405	58	0.64 595	9.98 919	2	16
45	9.34 380	56	9.35 464	59	0.64 536	9.98 916	3	15
46	9.34 436	56	9.35 523	59	0.64 477	9.98 913	3	14
47	9.34 491	55	9.35 581	58	0.64 419	9.98 910	3	13
48	9.34 547	56	9.35 640	59	0.64 360	9.98 907	3	12
49	9.34 602	55	9.35 698	58	0.64 302	9.98 904	3	11
50	9.34 658	56	9.35 757	59	0.64 243	9.98 901	3	**10**
51	9.34 713	55	9.35 815	58	0.64 185	9.98 898	3	9
52	9.34 769	56	9.35 873	58	0.64 127	9.98 896	2	8
53	9.34 824	55	9.35 931	58	0.64 069	9.98 893	3	7
54	9.34 879	55	9.35 989	58	0.64 011	9.98 890	3	6
55	9.34 934	55	9.36 047	58	0.63 953	9.98 887	3	5
56	9.34 989	55	9.36 105	58	0.63 895	9.98 884	3	4
57	9.35 044	55	9.36 163	58	0.63 837	9.98 881	3	3
58	9.35 099	55	9.35 221	58	0.63 779	9.98 878	3	2
59	9.35 154	55	9.36 279	58	0.63 721	9.98 875	3	1
60	9.35 209	55	9.36 336	57	0.63.664	9.98 872	3	**0**
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	'

P. P.

	63	**62**	**61**
1	1,0	1,0	1,0
2	2,1	2,0	2,0
3	3,2	3,1	3,0
4	4,2	4,1	4,1
5	5,2	5,2	5,1
6	6,3	6,2	6,1
7	7,4	7,2	7,1
8	8,4	8,3	8,1
9	9,4	9,3	9,2
10	10,5	10,3	10,2
20	21,0	20,7	20,3
30	31,5	31,0	30'5
40	42,0	41,3	40,7
50	52,5	51,7	50,8

	60	**59**	**58**
1	1,0	1,0	1,0
2	2,0	2,0	1,9
3	3,0	3,0	2,9
4	4,0	3,9	3,9
5	5,0	4,9	4,8
6	6,0	5,9	5,8
7	7,0	6,9	6,8
8	8,0	7,9	7,7
9	9,0	8,8	8,7
10	10,0	9,8	9,7
20	20,0	19,7	19'3
30	30,0	29,5	29'0
40	40,0	39'3	38'7
50	50,0	49'2	48'3

	57	**56**	**55**
1	1,0	0,9	0,9
2	1,9	1,9	1,8
3	2,8	2,8	2,8
4	3,8	3,7	3,7
5	4'8	4,7	4,6
6	5,7	5,6	5,5
7	6,6	6,5	6,4
8	7,6	7,5	7,3
9	8,6	8,4	8,2
10	9,5	9,3	9,2
20	19,0	18,7	18,3
30	28,5	28,0	27,5
40	38,0	37,3	36,7
50	47,5	46,7	45,8

	$\frac{3}{62}$	$\frac{3}{61}$	$\frac{3}{60}$
0	10,3	10,2	10,0
1	31,0	30,5	30,0
2	51,7	50,8	50,0
3			

	$\frac{3}{59}$	$\frac{3}{58}$	$\frac{3}{57}$
0	9,8	9,7	9,5
1	29,5	29,0	28'5
2	49,2	48,3	47'5
3			

P. P.

77°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

13°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.35 209		9.36 336		0.63 664	9.98 872		60
1	9.35 263	54	9.36 394	58	0.63 606	9.98 869	3	59
2	9.35 318	55	9.36 452	58	0.63 548	9.98 867	2	58
3	9.35 373	55	9.36 509	57	0.63 491	9.98 864	3	57
4	9.35 427	54	9.36 566	57	0.63 434	9.98 861	3	56
5	9.35 481	54	9.36 624	58	0.63 376	9.98 858	3	55
6	9.35 536	55	9.36 681	57	0.63 319	9.98 855	3	54
7	9.35 590	54	9.36 738	57	0.63 262	9.98 852	3	53
8	9.35 644	54	9.36 795	57	0.63 205	9.98 849	3	52
9	9.35 698	54	9.36 852	57	0.63 148	9.98 846	3	51
10	9.35 752	54	9.36 909	57	0.63 091	9.98 843	3	50
11	9.35 806	54	9.36 966	57	0.63 034	9.98 840	3	49
12	9.35 860	54	9.37 023	57	0.62 977	9.98 837	3	48
13	9.35 914	54	9.37 080	57	0.62 920	9.98 834	3	47
14	9.35 968	54	9.37 137	57	0.62 863	9.98 831	3	46
15	9.36 022	54	9.37 193	56	0.62 807	9.98 828	3	45
16	9.36 075	53	9.37 250	57	0.62 750	9.98 825	3	44
17	9.36 129	54	9.37 306	56	0.62 694	9.98 822	3	43
18	9.36 182	53	9.37 363	57	0.62 637	9.98 819	3	42
19	9.36 236	54	9.37 419	56	0.62 581	9.98 816	3	41
20	9.36 289	53	9.37 476	57	0.62 524	9.98 813	3	40
21	9.36 342	53	9.37 532	56	0.62 468	9.98 810	3	39
22	9.36 395	53	9.37 588	56	0.62 412	9.98 807	3	38
23	9.36 449	54	9.37 644	56	0.62 356	9.98 804	3	37
24	9.36 502	53	9.37 700	56	0.62 300	9.98 801	3	36
25	9.36 555	53	9.37 756	56	0.62 244	9.98 798	3	35
26	9.36 608	53	9.37 812	56	0.62 188	9.98 795	3	34
27	9.36 660	52	9.37 868	56	0.62 132	9.98 792	3	33
28	9.36 713	53	9.37 924	56	5.62 076	9.98 789	3	32
29	9.36 766	53	9.37 980	56	0.62 020	9.98 786	3	31
30	9.36 819	53	9.38 035	55	0.61 965	9.98 783	3	30
31	9.36 871	52	9.38 091	56	0.61 909	9.98 780	3	29
32	9.36 924	53	9.38 147	56	0.61 853	9.98 777	3	28
33	9.36 976	52	9.38 202	55	0.61 798	9.98 774	3	27
34	9.37 028	52	9.38 257	55	0.61 743	9.98 771	3	26
35	9.37 081	53	9.38 313	56	0.61 687	9.98 768	3	25
36	9.37 133	52	9.38 368	55	0.61 632	9.98 765	3	24
37	9.37 185	52	9.38 423	55	0.61 577	9.98 762	3	23
38	9.37 237	52	9.38 479	56	0.61 521	9.98 759	3	22
39	9.37 289	52	9.38 534	55	0.61 466	9.98 756	3	21
40	9.37 341	52	9.38 589	55	0.61 411	9.98 753	3	20
41	9.37 393	52	9.38 644	55	0.61 356	9.98 750	3	19
42	9.37 445	52	9.38 699	55	0.61 301	9.98 746	4	18
43	9.37 497	52	9.38 754	55	0.61 246	9.98 743	3	17
44	9.37 549	52	9.38 808	54	0.61 192	9.98 740	3	16
45	9.37 600	51	9.38 863	55	0.61 137	9.98 737	3	15
46	9.37 652	52	9.38 918	55	0.61 082	9.98 734	3	14
47	9.37 703	51	9.38 972	54	0.61 028	9.98 731	3	13
48	9.37 755	52	9.39 027	55	0.60 973	9.98 728	3	12
49	9.37 806	51	9.39 082	55	0.60 918	9.98 725	3	11
50	9.37 858	52	9.39 136	54	0.60 864	9.98 722	3	10
51	9.37 909	51	9.39 190	54	0.60 810	9.98 719	3	9
52	9.37 960	51	9.39 245	55	0.60 755	9.98 715	4	8
53	9.38 011	51	9.39 299	54	0.60 701	9.98 712	3	7
54	9.38 062	51	9.39 353	54	0.60 647	9.98 709	3	6
55	9.38 113	51	9.39 407	54	0.60 593	9.98 706	3	5
56	9.38 164	51	9.39 461	54	0.60 539	9.98 703	3	4
57	9.38 215	51	9.39 515	54	0.60 485	9.98 700	3	3
58	9.38 266	51	9.39 569	54	0.60 431	9.98 697	3	2
59	9.38 317	51	9.39 623	54	0.60 377	9.98 694	3	1
60	9.38 368	51	9.39 677	54	0.60 323	9.98 690	4	0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	57	56	55
1	1,0	0,9	0,9
2	1,9	1,9	1,8
3	2,8	2,8	2,8
4	3,8	3,7	3,7
5	4,8	4,7	4,6
6	5,7	5,6	5,5
7	6,6	6,5	6,4
8	7,6	7,5	7,3
9	8,6	8,4	8,2
10	9,5	9,3	9,2
20	19,0	18,7	18,3
30	28,5	28,0	27,5
40	38,0	37,3	36,7
50	47,5	46,7	45,8

	54	53	52
1	0,9	0,9	0,9
2	1,8	1,8	1,7
3	2,7	2,6	2,6
4	3,6	3,5	3,5
5	4,5	4,4	4,3
6	5,4	5,3	5,2
7	6,3	6,2	6,1
8	7,2	7,1	6,9
9	8,1	8,0	7,8
10	9,0	8,8	8,7
20	18,0	17,7	17,3
30	27,0	26,5	26,0
40	36,0	35,3	34,7
50	45,0	44,2	43,3

	51	4	3	2
1	0,8	0,1	0,0	0,0
2	1,7	0,1	0,1	0,1
3	2,6	0,2	0,2	0,1
4	3,4	0,3	0,2	0,1
5	4,2	0,3	0,2	0,2
6	5,1	0,4	0,3	0,2
7	6,0	0,5	0,4	0,2
8	6,8	0,5	0,4	0,3
9	7,6	0,6	0,4	0,3
10	8,5	0,7	0,5	0,3
20	17,0	1,3	1,0	0,7
30	25,5	2,0	1,5	1,0
40	34,0	2,7	2,0	1,3
50	42,5	3,3	2,5	1,7

	$\frac{4}{55}$	$\frac{4}{54}$	$\frac{3}{58}$	$\frac{3}{57}$
0	6,9	6,8	9,7	9,5
1	20,6	20,2	29,0	28,5
2	34,4	33,8	48,3	47,5
3	48,1	47,2	—	—
4				

	$\frac{3}{56}$	$\frac{3}{55}$	$\frac{3}{54}$
0	9,3	9,2	9,0
1	28,0	27,5	27,0
2	46,7	45,8	45,0
3			

P. P.

76°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

14°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.38 368		9.39 677		0.60 323	9.98 690		60
1	9.38 418	50	9.39 731	54	0.60 269	9.98 687	3	59
2	9.38 469	51	9.39 785	54	0.60 215	9.98 684	3	58
3	9.38 519	50	9.39 838	53	0.60 162	9.98 681	3	57
4	9.38 570	51	9.39 892	54	0.60 108	9.98 678	3	56
5	9.38 620	50	9.39 945	53	0.60 055	9.98 675	3	55
6	9.38 670	50	9.39 999	54	0.60 001	9.98 671	4	54
7	9.38 721	51	9.40 052	53	0.59 948	9.98 688	3	53
8	9.38 771	50	9.40 106	54	0.59 894	9.98 665	3	52
9	9.38 821	50	9.40 159	53	0.59 841	9.98 662	3	51
10	9.38 871	50	9.40 212	53	0.59 788	9.98 659	3	50
11	9.38 921	50	9.40 266	54	0.59 734	9.98 656	3	49
12	9.38 971	50	9.40 319	53	0.59 681	9.98 652	4	48
13	9.39 021	50	9.40 372	53	0.59 628	9.98 649	3	47
14	9.39 071	50	9.40 425	53	0.59 575	9.98 646	3	46
15	9.39 121	50	9.40 478	53	0.59 522	9.98 643	3	45
16	9.39 170	49	9.40 531	53	0.59 469	9.98 640	3	44
17	9.39 220	50	9.40 584	53	0.59 416	9.98 636	4	43
18	9.39 270	50	9.40 636	52	0.59 364	9.98 633	3	42
19	9.39 319	49	9.40 689	53	0.59 311	9.98 630	3	41
20	9.39 369	50	9.40 742	53	0.59 258	9.98 627	3	40
21	9.39 418	49	9.40 795	53	0.59 205	9.98 623	4	39
22	9.39 467	49	9.40 847	52	0.59 153	9.98 620	3	38
23	9.39 517	50	9.40 900	53	0.59 100	9.98 617	3	37
24	9.39 566	49	9.40 952	52	0.59 048	9.98 614	3	36
25	9.39 615	49	9.41 005	53	0.58 995	9.98 610	4	35
26	9.39 664	49	9.41 057	52	0.58 943	9.98 607	3	34
27	9.39 713	49	9.41 109	52	0.58 891	9.98 604	3	33
28	9.39 762	49	9.41 161	52	0.58 839	9.98 601	3	32
29	9.39 811	49	9.41 214	53	0.58 786	9.98 597	4	31
30	9.39 860	49	9.41 266	52	0.58 734	9.98 594	3	30
31	9.39 909	49	9.41 318	52	0.58 682	9.98 591	3	29
32	9.39 958	49	9.41 370	52	0.58 630	9.98 588	3	28
33	9.40 006	48	9.41 422	52	0.58 578	9.98 584	4	27
34	9.40 055	49	9.41 474	52	0.58 526	9.98 581	3	26
35	9.40 103	48	9.41 526	52	0.58 474	9.98 578	3	25
36	9.40 152	49	9.41 578	52	0.58 422	9.98 574	4	24
37	9.40 200	48	9.41 629	51	0.58 371	9.98 571	3	23
38	9.40 249	49	9.41 681	52	0.58 319	9.98 568	3	22
39	9.40 297	48	9.41 733	52	0.58 267	9.98 565	3	21
40	9.40 346	49	9.41 784	51	0.58 216	9.98 561	4	20
41	9.40 394	48	9.41 836	52	0.58 164	9.98 558	3	19
42	9.40 442	48	9.41 887	51	0.58 113	9.98 555	3	18
43	9.40 490	48	9.41 939	52	0.55 061	9.98 551	4	17
44	9.40 538	48	9.41 990	51	0.58 010	9.98 548	3	16
45	9.40 586	48	9.42 041	51	0.57 959	9.98 545	3	15
46	9.40 634	48	9.42 093	52	0.57 907	9.98 541	4	14
47	9.40 682	48	9.42 144	51	0.57 856	9.98 538	3	13
48	9.40 730	48	9.42 195	51	0.57 805	9.98 535	3	12
49	9.40 778	48	9.42 246	51	0.57 754	9.98 531	4	11
50	9.40 825	47	9.42 297	51	0.57 703	9.98 528	3	10
51	9.40 873	48	9.42 348	51	0.57 652	9.98 525	3	9
52	9.40 921	48	9.42 399	51	0.57 601	9.98 521	4	8
53	9.40 968	47	9.42 450	51	0.57 550	9.98 518	3	7
54	9.41 016	48	9.42 501	51	0.57 499	9.98 515	3	6
55	9.41 063	47	9.42 552	51	0.57 448	9.98 511	4	5
56	9.41 111	48	9.42 603	51	0.57 397	9.98 508	3	4
57	9.41 158	47	9.42 653	50	0.57 347	9.98 505	3	3
58	9.41 205	47	9.43 704	51	0.57 296	9.98 501	4	2
59	9.41 252	47	9.42 755	51	0.57 245	9.98 498	3	1
60	9.41 300	48	9.42 805	50	0.57 195	9.98 494	4	0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	54	53	52
1	0,9	0,9	0,9
2	1,8	1,8	1,7
3	2,7	2,6	2,6
4	3,6	3,5	3,5
5	4,5	4,4	4,3
6	5,4	5,3	5,2
7	6,3	6,2	6,1
8	7,2	7,1	6,9
9	8,1	8,0	7,8
10	9,0	8,8	8,7
20	18,0	17,7	17,3
30	27,0	26,5	26,0
40	36,0	35,3	34,7
50	45,0	44,2	43,3

	51	50	49
1	0,8	0,8	0,8
2	1,7	1,7	1,6
3	2,6	2,5	2,4
4	3,4	3,3	3,3
5	4,2	4,2	4,1
6	5,1	5,0	4,9
7	6,0	5,8	5,7
8	6,8	6,7	6,5
9	7,6	7,5	7,4
10	8,5	8,3	8,2
20	17,0	16,7	16,3
30	25,5	25,0	24,5
40	34,0	33,3	32,7
50	42,5	41,7	40,8

	48	47	4	3
1	0,8	0,8	0,1	0,0
2	1,6	1,6	0,1	0,1
3	2,4	2,4	0,2	0,2
4	3,2	3,1	0,3	0,2
5	4,0	3,9	0,3	0,2
6	4,8	4,7	0,4	0,3
7	5,6	5,5	0,5	0,4
8	6,4	6,3	0,5	0,4
9	7,2	7,0	0,6	0,4
10	8,0	7,8	0,7	0,5
20	16,0	15,7	1,3	1,0
30	24,0	23,5	2,0	1,5
40	32,0	31,3	2,7	2,0
50	40,0	39,2	3,3	2,5

	$\frac{4}{54}$	$\frac{4}{53}$	$\frac{4}{52}$	$\frac{4}{51}$
0				
1	6,8	6,6	6,5	6,4
2	20,2	19,9	19,5	19,1
3	33,8	33,1	32,5	31,9
4	47,2	46,4	45,5	44,6

	$\frac{3}{54}$	$\frac{3}{53}$	$\frac{3}{52}$	$\frac{3}{51}$
0				
1	9,0	8,8	8,7	8,5
2	27,0	26,5	26,0	25,5
3	45,0	44,2	43,3	42,5

P. P.

75°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

15°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.41 300	47	9.42 805	51	0.57 195	9.98 494	3	60
1	9.41 347	47	9.42 856	59	0.57 144	9.98 491	3	59
2	9.41 394	47	9.42 906	51	0.57 094	9.98 488	4	58
3	9.41 441	47	9.42 957	50	0.57 043	9.98 484	3	57
4	9.41 488	47	9.43 007	50	0.56 993	9.98 481	4	56
5	9.41 535	47	9.43 057	51	0.56 943	9.98 477	3	55
6	9.41 582	46	9.43 108	50	0.56 892	9.98 474	3	54
7	9.41 628	47	9.43 158	50	0.56 842	9.98 471	4	53
8	9.41 675	47	9.43 208	50	0.56 792	9.98 467	3	52
9	9.41 722	46	9.43 258	50	0.56 742	9.98 464	4	51
10	9.41 768	47	9.43 308	50	0.56 692	9.98 460	3	50
11	9.41 815	46	9.43 358	50	0.56 642	9.98 457	4	49
12	9.41 861	47	9.43 408	50	0.56 592	9.98 453	3	48
13	9.41 908	46	9.43 458	50	0.56 542	9.98 450	3	47
14	9.41 954	47	9.43 508	50	0.56 492	9.98 447	4	46
15	9.42 001	46	9.43 558	49	0.56 442	9.98 443	3	45
16	9.42 047	46	9.43 607	50	0.56 393	9.98 440	4	44
17	9.42 093	47	9.43 657	50	0.56 343	9.98 436	3	43
18	9.42 140	46	9.43 707	49	0.56 293	9.98 433	4	42
19	9.42 186	46	9.43 756	50	0.56 244	9.98 429	3	41
20	9.42 232	46	9.43 806	49	0.56 194	9.98 426	4	40
21	9.42 278	46	9.43 855	50	0.56 145	9.98 422	3	39
22	9.42 324	46	9.43 905	49	0.56 095	9.98 419	4	38
23	9.42 370	46	9.43 954	50	0.56 046	9.98 415	3	37
24	9.42 416	45	9.44 004	49	0.55 996	9.98 412	3	36
25	9.42 461	46	9.44 053	49	0.55 947	9.98 409	4	35
26	9.42 507	46	9.44 102	49	0.55 898	9.98 405	3	34
27	9.42 553	46	9.44 151	50	0.55 849	9.98 402	4	33
28	9.42 599	45	9.44 201	49	0.55 799	9.98 398	3	32
29	9.42 644	46	9.44 250	49	0.55 750	9.98 395	4	31
30	9.42 690	45	9.44 299	49	0.55 701	9.98 391	3	30
31	9.42 735	46	9.44 348	49	0.55 652	9.98 388	4	29
32	9.42 781	45	9.44 397	49	0.55 603	9.98 384	3	28
33	9.42 826	46	9.44 446	49	0.55 554	9.98 381	4	27
34	9.42 872	45	9.44 495	49	0.55 505	9.98 377	4	26
35	9.42 917	45	9.44 544	48	0.55 456	9.98 373	3	25
36	9.42 962	46	9.44 592	49	0.55 408	9.98 370	4	24
37	9.43 008	45	9.44 641	49	0.55 359	9.98 366	3	23
38	9.43 053	45	9.44 690	48	0.55 310	9.98 363	4	22
39	9.43 098	45	9.44 738	49	0.55 262	9.98 359	3	21
40	9.43 143	45	9.44 787	49	0.55 213	9.98 356	4	20
41	9.43 188	45	9.44 836	48	0.55 164	9.98 352	3	19
42	9.43 233	45	9.44 884	49	0.55 116	9.98 349	4	18
43	9.43 278	45	9.44 933	48	0.55 067	9.98 345	3	17
44	9.43 323	44	9.44 981	48	0.55 019	9.98 342	4	16
45	9.43 367	45	9.45 029	49	0.54 971	9.98 338	4	15
46	9.43 412	45	9.45 078	48	0.54 922	9.98 334	3	14
47	9.43 457	45	9.45 126	48	0.54 874	9.98 331	4	13
48	9.43 502	44	9.45 174	48	0.54 826	9.98 327	3	12
49	9.43 546	45	9.45 222	49	0.54 778	9.98 324	4	11
50	9.43 591	44	9.45 271	48	0.54 729	9.98 320	3	10
51	9.43 635	45	9.45 319	48	0.54 681	9.98 317	4	9
52	9.43 680	44	9.45 367	48	0.54 633	9.98 313	4	8
53	9.43 724	45	9.45 415	48	0.54 585	9.98 309	3	7
54	9.43 769	44	9.45 463	48	0.54 537	9.98 306	4	6
55	9.43 813	44	9.45 511	48	0.54 489	9.98 302	3	5
56	9.43 857	44	9.45 559	47	0.54 441	9.98 299	4	4
57	9.43 901	45	9.45 606	48	0.54 394	9.98 295	4	3
58	9.43 946	44	9.45 654	48	0.54 346	9.98 291	3	2
59	9.43 990	44	9.45 702	48	0.54 298	9.98 288	4	1
60	9.44 034		9.45 750		0.54 250	9.98 284		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	51	50	49
1	0,8	0,8	0,8
2	1,7	1,7	1,6
3	2,6	2,5	2,4
4	3,4	3,3	3,3
5	4,2	4,2	4,1
6	5,1	5,0	4,9
7	6,0	5,8	5,7
8	6,8	6,7	6,5
9	7,6	7,5	7,4
10	8,5	8,3	8,2
20	17,0	16,7	16,3
30	25,5	25,0	24,5
40	34,0	33,3	32,7
50	42,5	41,7	40,8

	48	47	46
1	0,8	0,8	0,8
2	1,6	1,6	1,5
3	2,4	2,4	2,3
4	3,2	3,1	3,1
5	4,0	3,9	3,8
6	4,8	4,7	4,6
7	5,6	5,5	5,4
8	6,4	6,3	6,1
9	7,2	7,0	6,9
10	8,0	7,8	7,7
20	16,0	15,7	15,3
30	24,0	23,5	23,0
40	32,0	31,3	30,7
50	40,0	39,2	38,3

	45	44	4	3
1	0,8	0,7	0,1	0,0
2	1,5	1,5	0,1	0,1
3	2,2	2,2	0,2	0,2
4	3,0	2,9	0,3	0,2
5	3,8	3,7	0,3	0,2
6	4,5	4,4	0,4	0,3
7	5,2	5,1	0,5	0,4
8	6,0	5,9	0,5	0,4
9	6,8	6,6	0,6	0,4
10	7,5	7,3	0,7	0,5
20	15,0	14,7	1,3	1,0
30	22,5	22,0	2,0	1,5
40	30,0	29,3	2,7	2,0
50	37,5	36,7	3,3	2,5

	4/50	4/49	4/48	4/47
0	6,2	6,1	6,0	5,9
1	18,8	18,4	18,0	17,6
2	31,2	30,6	30,0	29,4
3	43,8	42,9	42,0	41,1
4				

	3/51	3/50	3/49	3/48
0	8,5	8,3	8,2	8,0
1	25,5	25,0	24,5	24,0
2	42,5	41,7	40,8	40,0
3				

P. P.

74°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

16°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.44 034	44	9.45 750	47	0.54 250	9.98 284	3	60
1	9.44 078	44	9.45 797	48	0.54 203	9.98 281	4	59
2	9.44 122	44	9.45 845	47	0.54 155	9.98 277	4	58
3	9.44 166	44	9.45 892	48	0.54 108	9.98 273	3	57
4	9.44 210	43	9.45 940	47	0.54 060	9.98 270	4	56
5	9.44 253	44	9.45 987	48	0.54 013	9.98 266	4	55
6	9.44 297	44	9.46 035	47	0.53 965	9.98 262	3	54
7	9.44 341	44	9.46 082	48	0.53 918	9.98 259	4	53
8	9.44 385	43	9.46 130	47	0.53 870	9.98 255	4	52
9	9.44 428	44	9.46 177	47	0.53 823	9.98 251	3	51
10	9.44 472	44	9.46 224	47	0.53 776	9.98 248	4	50
11	9.44 516	43	9.46 271	48	0.53 729	9.98 244	4	49
12	9.44 559	43	9.46 319	47	0.53 681	9.98 240	3	48
13	9.44 602	44	9.46 366	47	0.53 634	9.98 237	4	47
14	9.44 646	43	9.46 413	47	0.53 587	9.98 233	4	46
15	9.44 689	44	9.46 460	47	0.53 540	9.98 229	3	45
16	9.44 733	43	9.46 507	47	0.53 493	9.98 226	4	44
17	9.44 776	43	9.46 554	47	0.53 446	9.98 222	4	43
18	9.44 819	43	9.46 601	47	0.53 399	9.98 218	3	42
19	9.44 862	43	9.46 648	46	0.53 352	9.98 215	4	41
20	9.44 905	43	9.46 694	47	0.53 306	9.98 211	4	40
21	9.44 948	44	9.46 741	47	0.53 259	9.98 207	3	39
22	9.44 992	43	9.46 788	47	0.53 212	9.98 204	4	38
23	9.45 035	42	9.46 835	46	0.53 165	9.98 200	4	37
24	9.45 077	43	9.46 881	47	0.53 119	9.98 196	4	36
25	9.45 120	43	9.46 928	47	0.53 072	9.98 192	3	35
26	9.45 163	43	9.46 975	46	0.53 025	9.98 189	4	34
27	9.45 206	43	9.47 021	47	0.52 979	9.98 185	4	33
28	9.45 249	43	9.47 068	46	0.52 932	9.98 181	4	32
29	9.45 292	42	9.47 114	46	0.52 886	9.98 177	3	31
30	9.45 334	43	9.47 160	47	0.52 840	9.98 174	4	30
31	9.45 377	42	9.47 207	46	0.52 793	9.98 170	4	29
32	9.45 419	43	9.47 253	46	0.52 747	9.98 166	4	28
33	9.45 462	42	9.47 299	47	0.52 701	9.98 162	3	27
34	9.45 504	43	9.47 346	46	0.52 654	9.98 159	4	26
35	9.45 547	42	9.47 392	46	0.52 608	9.98 155	4	25
36	9.45 589	43	9.47 438	46	0.52 562	9.98 151	4	24
37	9.45 632	42	9.47 484	46	0.52 516	9.98 147	3	23
38	9.45 674	42	9.47 530	46	0.52 470	9.98 144	4	22
39	9.45 716	42	9.47 576	46	0.52 424	9.98 140	4	21
40	9.45 758	43	9.47 622	46	0.52 378	9.98 136	4	20
41	9.45 801	42	9.47 668	46	0.52 332	9.98 132	3	19
42	9.45 843	42	9.47 714	46	0.52 286	9.98 129	4	18
43	9.45 885	42	9.47 760	46	0.52 240	9.98 125	4	17
44	9.45 927	42	9.47 806	46	0.52 194	9.98 121	4	16
45	9.45 969	42	9.47 852	45	0.52 148	9.98 117	4	15
46	9.46 011	42	9.47 897	46	0.52 103	9.98 113	3	14
47	9.46 053	42	9.47 943	46	0.52 057	9.98 110	4	13
48	9.46 095	41	9.47 989	46	0.52 011	9.98 106	4	12
49	9.46 136	42	9.48 035	45	0.51 965	9.98 102	4	11
50	9.46 178	42	9.48 080	46	0.51 920	9.98 098	4	10
51	9.46 220	42	9.48 126	45	0.51 874	9.98 094	4	9
52	9.46 262	41	9.48 171	46	0.51 829	9.98 090	3	8
53	9.46 303	42	9.48 217	45	0.51 783	9.98 087	4	7
54	9.46 345	41	9.48 262	45	0.51 738	9.98 083	4	6
55	9.46 386	42	9.48 307	46	0.51 693	9.98 079	4	5
56	9.46 428	41	9.48 353	45	0.51 647	9.98 075	4	4
57	9.46 469	42	9.48 398	45	0.51 602	9.98 071	4	3
58	9.46 511	41	9.48 443	46	0.51 557	9.98 067	4	2
59	9.46 552	42	9.48 489	45	0.51 511	9.98 063	3	1
60	9.46 594		9.48 534		0.51 466	9.98 060		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	48	47	46
1	0,8	0,8	0,8
2	1,6	1,6	1,5
3	2,4	2,4	2,3
4	3,2	3,1	3,1
5	4,0	3,9	3,8
6	4,8	4,7	4,6
7	5,6	5,5	5,4
8	6,4	6,3	6,1
9	7,2	7,0	6,9
10	8,0	7,8	7,7
20	16,0	15,7	15,3
30	24,0	23,5	23,0
40	32,0	31,3	30,7
50	40,0	39,2	38,3

	45	44	43
1	0,8	0,7	0,7
2	1,5	1,5	1,4
3	2,2	2,2	2,2
4	3,0	2,9	2,9
5	3,8	3,7	3,6
6	4,5	4,4	4,3
7	5,2	5,1	5,0
8	6,0	5,9	5,7
9	6,8	6,6	6,4
10	7,5	7,3	7,2
20	15,0	14,7	14,3
30	22,5	22,0	21,5
40	30,0	29,3	28,7
50	37,5	36,7	35,8

	42	41	4	3
1	0,7	0,7	0,1	0,0
2	1,4	1,4	0,1	0,1
3	2,1	2,0	0,2	0,2
4	2,8	2,7	0,3	0,2
5	3,5	3,4	0,3	0,2
6	4,2	4,1	0,4	0,3
7	4,9	4,8	0,5	0,4
8	5,6	5,5	0,5	0,4
9	6,3	6,2	0,6	0,4
10	7,0	6,8	0,7	0,5
20	14,0	13,7	1,3	1,0
30	21,0	29,5	2,0	1,5
40	28,0	27,3	2,7	2,0
50	35,0	34,2	3,3	2,5

	$\frac{4}{48}$	$\frac{4}{47}$	$\frac{4}{46}$	$\frac{4}{45}$
0	6,0	5,9	5,8	5,6
1	18,0	17,6	17,2	16,9
2	30,0	29,4	28,8	28,1
3	42,0	41,1	40,2	39,4
4				

	$\frac{3}{48}$	$\frac{3}{47}$	$\frac{3}{46}$	$\frac{3}{45}$
0	8,0	7,8	7,7	7,5
1	24,0	23,5	23,0	22,5
2	40,0	39,2	38,3	37,5
3				

P. P.

73°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

17°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.46 594	41	9.48 534	45	0.51 466	9.98 060	4	60
1	9.46 635	41	9.48 579	45	0.51 421	9.98 056	4	59
2	9.46 676	41	9.48 624	45	0.51 376	9.98 052	4	58
3	9.46 717	41	9.48 669	45	0.51 331	9.98 048	4	57
4	9.46 758	42	9.48 714	45	0.51 286	9.98 044	4	56
5	9.46 800	41	9.48 759	45	0.51 241	9.98 040	4	55
6	9.46 841	41	9.48 804	45	0.51 196	9.98 036	4	54
7	9.46 882	41	4.48 849	45	0.51 151	9.98 032	3	53
8	9.46 923	41	9.48 894	45	0.51 106	9.98 029	4	52
9	9.46 964	41	9.48 939	45	0.51 061	9.98 025	4	51
10	9.47 005	40	9.48 984	45	0.51 016	9.98 021	4	**50**
11	9.47 045	41	9.49 029	44	0.50 971	9.98 017	4	49
12	9.47 086	41	9.49 073	45	0.50 927	9.98 013	4	48
13	9.47 127	41	9.49 118	45	0.50 882	9.98 009	4	47
14	9.47 168	41	9.49 163	44	0.50 837	9.98 005	4	46
15	9.47 209	40	9.49 207	45	0.50 793	9.98 001	4	45
16	9.47 249	41	9.49 252	44	0.50 748	9.97 997	4	44
17	9.47 290	40	9.49 296	45	0.50 704	9.97 993	4	43
18	9.47 330	41	9.49 341	44	0.50 659	9.97 989	3	42
19	9.47 371	40	9.49 385	45	0.50 615	9.97 986	4	41
20	9.47 411	41	9.49 430	44	0.50 570	9.97 982	4	**40**
21	9.47 452	40	9.49 474	45	0.50 526	9.97 978	4	39
22	9.47 492	41	9.49 519	44	0.50 481	9.97 974	4	38
23	9.47 533	40	9.49 563	44	0.50 437	9.97 970	4	37
24	9.47 573	40	9.49 607	45	0.50 393	9.97 966	4	36
25	9.47 613	41	9.49 652	44	0.50 348	9.97 962	4	35
26	9.47 654	40	9.49 696	44	0.50 304	9.97 958	4	34
27	9.47 694	40	9.49 740	44	0.50 260	9.97 954	4	33
28	9.47 734	40	9.49 784	44	0.50 216	9.37 950	4	32
29	9.47 774	40	9.49 828	44	0.50 172	9.97 946	4	31
30	9.47 814	40	9.49 872	44	0.50 128	9.97 942	4	**30**
31	9.47 854	40	9.49 916	44	0.50 084	9.97 938	4	29
32	9.47 894	40	9.49 960	44	0.50 040	9.97 934	4	28
33	9.47 934	40	9.50 004	44	0.49 996	9.97 930	4	27
34	9.47 974	40	9.50 048	44	0.49 952	9.97 926	4	26
35	9.48 014	40	9.50 092	44	0.49 908	9.97 622	4	25
36	9.48 054	40	9.50 136	44	0.49 864	9.97 918	4	24
37	9.48 094	39	9.50 180	43	0.49 820	9.97 914	4	23
38	9.48 133	40	9.50 223	44	0.49 777	9.97 910	4	22
39	9.48 173	40	9.50 267	44	0.49 733	9.97 906	4	21
40	9.48 213	39	9.50 311	44	0.49 689	9.97 902	4	**20**
41	9.48 252	40	9.50 355	43	0.49 645	9.97 898	4	19
42	9.48 292	40	9.50 398	44	0.49 602	9.97 894	4	18
43	9.48 332	39	9.50 442	43	0.49 558	9.97 890	4	17
44	9.48 371	40	9.50 485	44	0.49 515	9.97 886	4	16
45	9.48 411	39	9.50 529	43	0.49 471	9.97 882	4	15
46	9.48 450	40	9.50 572	44	0.49 428	9.97 878	4	14
47	9.48 490	39	9.50 616	43	0.49 384	9.97 874	4	13
48	9.48 529	39	9.50 659	44	0.49 341	9.97 870	4	12
49	9.48 568	39	9.50 703	43	0.49 297	9.97 866	5	11
50	9.48 607	40	9.50 746	43	0.49 254	9.97 861	4	**10**
51	9.48 647	39	9.50 789	44	0.49 211	9.97 857	4	9
52	9.43 686	39	9.50 833	43	0.49 167	9.97 853	4	8
53	9.48 725	39	9.50 876	43	0.49 124	9.97 849	4	7
54	9.48 764	39	9.50 919	43	0.49 081	9.97 845	4	6
55	9.48 803	39	9.50 962	43	0.49 038	9.97 841	4	5
56	9.48 842	39	9.51 005	43	0.48 995	9.97 837	4	4
57	9.48 881	39	9.51 048	44	0.48 952	9.97 833	4	3
58	9.48 920	39	9.51 092	43	0.48 908	9.97 829	4	2
59	9.48 959	39	9.51 135	43	0.48 865	9.97 825	4	1
60	9.48 998		9.51 178		0.48 822	9.97 821		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	45	44	43
1	0,8	0,7	0,7
2	1,5	1,5	1,4
3	2,2	2,2	2,2
4	3,0	2,9	2,9
5	3,8	3,7	3,6
6	4,5	4,4	4'3
7	5,2	5,1	5,0
8	6,0	5,9	5,7
9	6,8	6,6	6,4
10	7,5	7,3	7,2
20	15,0	14,7	14,3
30	22,5	22,0	21,5
40	30,0	29,3	28,7
50	37,5	36,7	35.8

	42	41	40
1	0,7	0,7	0,7
2	1,4	1,4	1,3
3	2,1	2,0	2,0
4	2,8	2,7	2,7
5	3,5	3,4	3'3
6	4,2	4,1	4,0
7	4,9	4,8	4,7
8	5,6	5,5	5,3
9	6,3	6,2	6,0
10	7,0	6,8	6,7
20	14,0	13,7	13,3
30	21,0	20,5	20,0
40	28,0	27,3	26,7
50	35,0	34,2	33,3

	39	5	4	3
1	0,6	0,1	0,1	0,0
2	1,3	0,2	0,1	0,1
3	2,0	0,2	0,2	0,2
4	2,6	0,3	0,3	0,2
5	3,2	0,4	0,3	0,2
6	3,9	0,5	0,4	0,3
7	4,6	0,6	0,5	0,4
8	5,2	0,7	0,5	0,4
9	5,8	0,8	0,6	0,4
10	6,5	0,8	0,7	0,5
20	13,0	1,7	1,3	1,0
30	19,5	2,5	2,0	1,5
40	26,0	3,3	2,7	2,0
50	32,5	4,2	3,3	2,5

	$\frac{5}{43}$	$\frac{4}{45}$	$\frac{4}{44}$
0	4,3	5,6	5,5
1	12,9	16,9	16,5
2	21,5	28,1	27,5
3	30,1	39,4	38,5
4	38,7	—	—
5			

	$\frac{4}{43}$	$\frac{3}{45}$	$\frac{3}{44}$
0	5,4	7,5	7,3
1	16,1	22,5	22,0
2	26,9	37,5	36,7
3	37,6	—	—
4			

P. P.

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TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

18°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.48 998	39	9.51 178	43	0.48 822	9.97 821	4	60
1	9.49 037	39	9.51 221	43	0.48 779	9.97 817	5	59
2	9.49 076	39	9.51 264	42	0.48 736	9.97 812	4	58
3	9.49 115	38	9.51 306	43	0.48 694	9.97 808	4	57
4	9.49 153	39	9.51 349	43	0.48 651	9.97 804	4	56
5	9.49 192	39	9.51 392	43	0.48 608	9.97 800	4	55
6	9.49 231	38	9.51 435	43	0.48 565	9.97 796	4	54
7	9.49 269	39	9.51 478	42	0.48 522	9.97 792	4	53
8	9.49 308	39	9.51 520	43	0.48 480	9.97 788	4	52
9	9.49 347	38	9.51 563	43	0.48 437	9.97 784	5	51
10	9.49 385	39	9.51 606	42	0.48 394	9.97 779	4	**50**
11	9.49 424	38	9.51 648	43	0.48 352	9.97 775	4	49
12	9.49 462	38	9.51 691	43	0.48 309	9.97 771	4	48
13	9.49 500	39	9.51 734	42	0.48 266	9.97 767	4	47
14	9.49 539	38	9.51 776	43	0.48 224	9.97 763	4	46
15	9.49 577	38	9.51 819	42	0.48 181	9.97 759	5	45
16	9.49 615	39	9.51 861	42	0.48 139	9.97 754	4	44
17	9.49 654	38	9.51 903	43	0.48 097	9.97 750	4	43
18	9.49 692	38	9.51 946	42	0.48 054	9.97 746	4	42
19	9.49 730	38	9.51 988	43	0.48 012	9.97 742	4	41
20	9.49 768	38	9.52 031	42	0.47 969	9.97 738	4	**40**
21	9.49 806	38	9.52 073	42	0.47 927	9.97 734	5	39
22	9.49 844	38	9.52 115	42	0.47 885	9.97 729	4	38
23	9.49 882	38	9.52 157	43	0.47 843	9.97 725	4	37
24	9.49 920	38	9.52 200	42	0.47 800	9.97 721	4	36
25	9.49 958	38	9.52 242	42	0.47 758	9.97 717	4	35
26	9.49 996	38	9.52 284	42	0.47 716	9.97 713	5	34
27	9.50 034	38	9.52 326	42	0.47 674	9.97 708	4	33
28	9.50 072	38	9.52 368	42	0.47 632	9.97 704	4	32
29	9.50 110	38	9.52 410	42	0.47 590	9.97 700	4	31
30	9.50 148	37	9.52 452	42	0.47 548	9.97 696	5	**30**
31	9.50 185	38	9.52 494	42	0.47 506	9.97 691	4	29
32	9.50 223	38	9.52 536	42	0.47 464	9.97 687	4	28
33	9.50 261	37	9.52 578	42	0.47 422	9.97 683	4	27
34	9.50 298	38	9.52 620	41	0.47 380	9.97 679	5	26
35	9.50 336	38	9.52 661	42	0.47 339	9.97 674	4	25
36	9.50 374	37	9.52 703	42	0.47 297	9.97 670	4	24
37	9.50 411	38	9.52 745	42	0.47 255	9.97 666	4	23
38	9.50 449	37	9.52 787	42	0.47 213	9.97 662	5	22
39	9.50 486	37	9.52 829	41	0.47 171	9.97 657	4	21
40	9.50 523	38	9.52 870	42	0.47 130	9.97 653	4	**20**
41	9.50 561	37	9.52 912	41	0.47 088	9.97 649	4	19
42	9.50 598	37	9.52 953	42	0.47 047	9.97 645	5	18
43	9.50 635	38	9.52 995	42	0.47 005	9.97 640	4	17
44	9.50 673	37	9.53 037	41	0.46 963	9.97 636	4	16
45	9.50 710	37	9.53 078	42	0.46 922	9.97 632	4	15
46	9.50 747	37	9.53 120	41	0.46 880	9.97 628	5	14
47	9.50 784	37	9.53 161	41	0.46 839	9.97 623	4	13
48	9.50 821	37	9.53 202	42	0.46 798	9.97 619	4	12
49	9.50 858	38	9.53 244	41	0.46 756	9.97 615	5	11
50	9.50 896	37	9.53 285	42	0.46 715	9.97 610	4	**10**
51	9.50 933	37	9.53 327	41	0.46 673	9.97 606	4	9
52	9.50 970	37	9.53 368	41	0.46 632	9.97 602	5	8
53	9.51 007	36	9.53 409	41	0.46 591	9.97 597	4	7
54	9.51 043	37	9.53 450	42	0.46 550	9.97 593	4	6
55	9.51 080	37	9.53 492	41	0.46 508	9.97 589	5	5
56	9.51 117	37	9.53 533	41	0.46 467	9.97 584	4	4
57	9.51 154	37	9.53 574	41	0.46 426	9.97 580	4	3
58	9.51 191	36	9.53 615	41	0.46 385	9.97 576	5	2
59	9.51 227	37	9.53 656	41	0.46 344	9.97 571	4	1
60	9.51 264		9.53 697		0.46 303	9.97 567		**0**
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	43	42	41
1	0,7	0,7	0,7
2	1,4	1,4	1,4
3	2,2	2,1	2,0
4	2,9	2,8	2,7
5	3,6	3,5	3,4
6	4,3	4,2	4,1
7	5,0	4,9	4,8
8	5,7	5,6	5,5
9	6,4	6,3	6,2
10	7,2	7,0	6,8
20	14,3	14,0	13,7
30	21,5	21,0	20,5
40	28,7	28,0	27,3
50	35,8	35,0	34,2

	39	38	37
1	0,6	0,6	0,6
2	1,3	1,3	1,2
3	2,0	1,9	1,8
4	2,6	2,5	2,5
5	3,2	3,2	3,1
6	3,9	3,8	3,7
7	4,6	4,4	4,3
8	5,2	5,1	4,9
9	5,8	5,7	5,6
10	6,5	6,3	6,2
20	13,0	12,7	12,3
30	19,5	19,0	18,5
40	26,0	25,3	24,7
50	32,5	31,7	30,8

	36	5	4
1	0,6	0,1	0,1
2	1,2	0,2	0,1
3	1,8	0,2	0,2
4	2,4	0,3	0,3
5	3,0	0,4	0,3
6	3,6	0,5	0,4
7	4,2	0,6	0,5
8	4,8	0,7	0,5
9	5,4	0,8	0,6
10	6,0	0,8	0,7
20	12,0	1,7	1,3
30	18,0	2,5	2,0
40	24,0	3,3	2,7
50	30,0	4,2	3,3

	5/43	5/42	5/41
0	4,3	4,2	4,1
1	12,9	12,6	12,3
2	21,5	21,0	20,5
3	30,1	29,4	28,7
4	38,7	37,8	36,9
5			

	4/43	4/42	4/41
0	5,4	5,2	5,1
1	16,1	15,8	15,4
2	26,9	26,2	25,6
3	37,6	36,8	35,9
4			

P. P.

71°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

19°

'	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.51 264		9.53 697		0.46 303	9.97 567		60
1	9.51 301	37	9.53 738	41	0.46 262	9.97 563	4	59
2	9.51 338	37	9.53 779	41	0.46 221	9.97 558	5	58
3	9.51 374	36	9.53 820	41	0.46 180	9.97 554	4	57
4	9.51 411	37	9.53 861	41	0.46 139	9.97 550	4	56
5	9.51 447	36	9.53 902	41	0.46 098	9.97 545	5	55
6	9.51 484	37	9.53 943	41	0.46 057	9.97 541	4	54
7	9.51 520	36	9.53 984	41	0.46 016	9.97 536	5	53
8	9.51 557	37	9.54 025	41	0.45 975	9.97 532	4	52
9	9.51 593	36	9.54 065	40	0.45 935	9.97 528	4	51
10	9.51 629	36	9.54 106	41	0.45 894	9.97 523	5	50
11	9.51 666	37	9.54 147	41	0.45 853	9.97 519	4	49
12	9.51 702	36	9.54 187	40	0.45 813	9.97 515	4	48
13	9.51 738	36	9.54 228	41	0.45 772	9.97 510	5	47
14	9.51 774	36	9.54 269	41	0.45 731	9.97 506	4	46
15	9.51 811	37	9.54 309	40	0.45 691	9.97 501	5	45
16	9.51 847	36	9.54 350	41	0.45 650	9.97 497	4	44
17	9.51 883	36	9.54 390	40	0.45 610	9.97 492	5	43
18	9.51 919	36	9.54 431	41	0.45 569	9.97 488	4	42
19	9.51 955	36	9.54 471	40	0.45 529	9.97 484	4	41
20	9.51 991	36	9.54 512	41	0.45 488	9.97 479	5	40
21	9.52 027	36	9.54 552	40	0.45 448	9.97 475	4	39
22	9.52 063	36	9.54 593	41	0.45 407	9.97 470	5	38
23	9.52 099	36	9.54 633	40	0.45 367	9.97 466	4	37
24	9.52 135	36	9.54 673	40	0.45 327	9.97 461	5	36
25	9.52 171	36	9.54 714	41	0.45 286	9.97 457	4	35
26	9.52 207	36	9.54 754	40	0.45 246	9.97 453	4	34
27	9.52 242	35	9.54 794	40	0.45 206	9.97 448	5	33
28	9.52 278	36	9.54 835	41	0.45 165	9.97 444	4	32
29	9.52 314	36	9.54 875	40	0.45 125	9.97 439	5	31
30	9.52 350	36	9.54 915	40	0.45 085	9.97 435	4	30
31	9.52 385	35	9.54 955	40	0.45 045	9.97 430	5	29
32	9.52 421	36	9.54 995	40	0.45 005	9.97 426	4	28
33	9.52 456	35	9.55 035	40	0.44 965	9.97 421	5	27
34	9.52 492	36	9.55 075	40	0.44 925	9.97 417	4	26
35	9.52 527	35	9.55 115	40	0.44 885	9.97 412	5	25
36	9.52 563	36	9.55 155	40	0.44 845	9.97 408	4	24
37	9.52 598	35	9.55 195	40	0.44 805	9.97 403	5	23
38	9.52 634	36	9.55 235	40	0.44 765	9.97 399	4	22
39	9.52 669	35	9.55 275	40	0.44 725	9.97 394	5	21
40	9.52 705	36	9.55 315	40	0.44 685	9.97 390	4	20
41	9.52 740	35	9.55 355	40	0.44 645	9.97 385	5	19
42	9.52 775	35	9.55 395	40	0.44 605	9.97 381	4	18
43	9.52 811	36	9.55 434	39	0.44 566	9.97 376	5	17
44	9.52 846	35	9.55 474	40	0.44 526	9.97 372	4	16
45	9.52 881	35	9.55 514	40	0.44 486	9.97 367	5	15
46	9.52 916	35	9.55 554	40	0.44 446	9.97 363	4	14
47	9.52 951	35	9.55 593	39	0.44 407	9.97 358	5	13
48	9.52 986	35	9.55 633	40	0.44 367	9.97 353	5	12
49	9.53 021	35	9.55 673	40	0.44 327	9.97 349	4	11
50	9.53 056	35	9.55 712	39	0.44 288	9.97 344	5	10
51	9.53 092	36	9.55 752	40	0.44 248	9.97 340	4	9
52	9.53 126	34	9.55 791	39	0.44 209	9.97 335	5	8
53	9.53 161	35	9.55 831	40	0.44 169	9.97 331	4	7
54	9.53 196	35	9.55 870	39	0.44 130	9.97 326	5	6
55	9.53 231	35	9.55 910	40	0.44 090	9.97 322	4	5
56	9.53 266	35	9.55 949	39	0.44 051	9.97 317	5	4
57	9.53 301	35	9.55 989	40	0.44 011	9.97 312	5	3
58	9.53 336	35	9.56 028	39	0.43 972	9.97 308	4	2
59	9.53 370	34	9.56 067	39	0.43 933	9.97 303	5	1
60	9.53 405	35	9.56 107	40	0.43 893	9.97 299	4	0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	'

P. P.

	41	**40**	**39**
1	0,7	0,7	0,6
2	1,4	1,3	1,3
3	2,0	2,0	2,0
4	2,7	2,7	2,6
5	3,4	3,3	3,2
6	4,1	4,0	3,9
7	4,8	4,7	4,6
8	5,5	5,3	5,2
9	6,2	6,0	5,8
10	6,8	6,7	6,5
20	13,7	13,3	13,0
30	20,5	20,0	19,5
40	27,3	26,7	26,0
50	34,2	33,3	32,5
	37	**36**	**35**
1	0,6	0,6	0'6
2	1,2	1,2	1,2
3	1,8	1,8	1,8
4	2,5	2,4	2,3
5	3,1	3,0	2,9
6	3,7	3,6	3,5
7	4,3	4,2	4,1
8	4,9	4,8	4,7
9	5'6	5,4	5,2
10	6,2	6,0	5,8
20	12,3	12,0	11,7
30	18,5	18,0	17,5
40	24'7	24,0	23'3
50	30,8	30,0	29,2
	34	**5**	**4**
1	0,6	0,1	0,1
2	1,1	0,2	0,1
3	1,7	0,2	0,2
4	2,3	0,3	0,3
5	2,8	0,4	0,3
6	3,4	0,5	0,4
7	4,0	0,6	0,5
8	4,5	0,7	0,5
9	5,1	0,8	0,6
10	5,7	0,8	0,7
20	11,3	1,7	1,3
30	17,0	2,5	2,0
40	22,7	3,3	2,7
50	28,3	4,2	3,3
	5 **41**	**5** **40**	**5** **39**
0	4,1	4,0	3,9
1	12,3	12,0	11,7
2	20,5	20,0	19,5
3	28,7	28,0	27,3
4	36,9	36,0	35,1
5			
	4 **41**	**4** **40**	**4** **39**
0	5,1	5,0	4,9
1	15,4	15,0	14,6
2	25,6	25,0	24,4
3	35,9	35,0	34,1
4			

P. P.

70°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

20°

'	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.53 405		9.56 107		0.43 893	9.97 299		**60**
1	9.53 440	35	9.56 146	39	0.43 854	9.97 294	5	59
2	9.53 475	35	9.56 185	39	0.43 815	9.97 289	5	58
3	9.53 509	34	9.56 224	39	0.43 776	9.97 285	4	57
4	9.53 544	35	9.56 264	40	0.43 736	9.97 280	5	56
5	9.53 578	34	9.56 303	39	0.43 697	9.97 276	4	55
6	9.53 613	35	9.56 342	39	0.43 658	9.97 271	5	54
7	9.53 647	34	9.56 381	39	0.43 619	9.97 266	5	53
8	9.53 682	35	9.56 420	39	0.43 580	9.97 262	4	52
9	9.53 716	34	9.56 459	39	0.43 541	9.97 257	5	51
10	9.53 751	35	9.56 498	39	0.43 502	9.97 252	5	**50**
11	9.53 785	34	9.56 537	39	0.43 463	9.97 248	4	49
12	9.53 819	34	9.56 576	39	0.43 424	9.97 243	5	48
13	9.53 854	35	9.56 615	39	0.43 385	9.97 238	5	47
14	9.53 888	34	9.56 654	39	0.43 346	9.97 234	4	46
15	9.53 922	34	9.56 693	39	0.43 307	9.97 229	5	45
16	9.53 957	35	9.56 732	39	0.43 268	9.97 224	5	44
17	9.53 991	34	9.56 771	39	0.43 229	9.97 220	4	43
18	9.54 025	34	9.56 810	39	0.43 190	9.97 215	5	42
19	9.54 059	34	9.56 849	39	0.43 151	9.97 210	5	41
20	9.54 093	34	9.56 887	38	0.43 113	9.97 206	4	**40**
21	9.54 127	34	9.56 926	39	0.43 074	9.97 201	5	39
22	9.54 161	34	9.56 965	39	0.43 035	9.97 196	5	38
23	9.54 195	34	9.57 004	39	0.42 996	9.97 192	4	37
24	9.54 229	34	9.57 042	38	0.42 958	9.97 187	5	36
25	9.54 263	34	9.57 081	39	0.42 919	9.97 182	5	35
26	9.54 297	34	9.57 120	39	0.42 880	9.97 178	4	34
27	9.54 331	34	9.57 158	38	0.42 842	9.97 173	5	33
28	9.54 365	34	9.57 197	39	0.42 803	9.97 168	5	32
29	9.54 399	34	9.57 235	38	0.42 765	9.97 163	5	31
30	9.54 433	34	9.57 274	39	0.42 726	9.97 159	4	**30**
31	9.54 466	33	9.57 312	38	0.42 688	9.97 154	5	29
32	9.54 500	34	9.57 351	39	0.42 649	9.97 149	5	28
33	9.54 534	34	9.57 389	38	0.42 611	9.97 145	4	27
34	9.54 567	33	9.57 428	39	0.42 572	9.97 140	5	26
35	9.54 601	34	9.57 466	38	0.42 534	9.97 135	5	25
36	9.54 635	34	9.57 504	38	0.42 496	9.97 130	5	24
37	9.54 668	33	9.57 543	39	0.42 457	9.97 126	4	23
38	9.54 702	34	9.57 581	38	0.42 419	9.97 121	5	22
39	9.54 735	33	9.57 619	38	0.42 381	9.97 116	5	21
40	9.54 769	34	9.57 658	39	0.42 342	9.97 111	5	**20**
41	9.54 802	33	9.57 696	38	0.42 304	9.97 107	4	19
42	9.54 836	34	9.57 734	38	0.42 266	9.97 102	5	18
43	9.54 869	33	9.57 772	38	0.42 228	9.97 097	5	17
44	9.54 903	34	9.57 810	38	0.42 190	9.97 092	5	16
45	9.54 936	33	9.57 849	39	0.42 151	9.97 087	5	15
46	9.54 969	33	9.57 887	38	0.42 113	9.97 083	4	14
47	9.55 003	34	9.57 925	38	0.42 075	9.97 078	5	13
48	9.55 036	33	9.57 963	38	0.42 037	9.97 073	5	12
49	9.55 069	33	9.58 001	38	0.41 999	9.97 068	5	11
50	9.55 102	33	9.58 039	38	0.41 961	9.97 063	5	**10**
51	9.55 136	34	9.58 077	38	0.41 923	9.97 059	4	9
52	9.55 169	33	9.58 115	38	0.41 885	9.97 054	5	8
53	9.55 202	33	9.58 153	38	0.41 847	9.97 049	5	7
54	9.55 235	33	9.58 191	38	0.41 809	9.97 044	5	6
55	9.55 268	33	9.58 229	38	0.41 771	9.97 039	5	5
56	9.55 301	33	9.58 267	38	0.41 733	9.97 035	4	4
57	9.55 334	33	9.58 304	37	0.41 696	9.97 030	5	3
58	9.55 367	33	9.58 342	38	0.41 658	9.97 025	5	2
59	9.55 400	33	9.58 380	38	0.41 620	9.97 020	5	1
60	9.55 433	33	9.58 418	38	0.41 582	9.97 015	5	**0**
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	'

P. P.

	40	**39**	**38**
1	0,7	0,6	0,6
2	1,3	1,3	1,3
3	2,0	2,0	1,9
4	2,7	2,6	2,5
5	3,3	3,2	3,2
6	4,0	3,9	3,8
7	4,7	4,6	4,4
8	5,3	5,2	5,1
9	6,0	5,8	5,7
10	6,7	6,5	6,3
20	13,3	13,0	12,7
30	20,0	19,5	19,0
40	26,7	26,0	25,3
50	33,3	32,5	31,7
	37	**35**	**34**
1	0,6	0,6	0,6
2	1,2	1,2	1,1
3	1,8	1,8	1,7
4	2,5	2,3	2,3
5	3,1	2,9	2,8
6	3,7	3,5	3,4
7	4,3	4,1	4,0
8	4,9	4,7	4,5
9	5,6	5,2	5,1
10	6,2	5,8	5,7
20	12,3	11,7	11,3
30	18,5	17,5	17,0
40	24,7	23,3	22,7
50	30,8	29,2	28,3
	33	**5**	**4**
1	0,6	0,1	0,1
2	1,1	0,2	0,1
3	1,6	0,2	0,2
4	2,2	0,3	0,3
5	2,8	0,4	0,3
6	3,3	0,5	0,4
7	3,8	0,6	0,5
8	4,4	0,7	0,5
9	5,0	0,8	0,6
10	5,5	0,8	0,7
20	11,0	1,7	1,3
30	16,5	2,5	2,0
40	22,0	3,3	2,7
50	27,5	4,2	3,3
	$\frac{5}{40}$	$\frac{5}{39}$	$\frac{5}{38}$
0	4,0	3,9	3,8
1	12,0	11,7	11,4
2	20,0	19,5	19,0
3	28,0	27,3	26,6
4	36,0	35,1	34,2
5			
	$\frac{5}{37}$	$\frac{4}{39}$	$\frac{4}{38}$
0	3,7	4,9	4,8
1	11,1	14,6	14,2
2	18,5	24,4	23,8
3	25,9	34,1	33,2
4	33,3		
5			

P. P.

69°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

21°

	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.55 433		9.58 418		0.41 582	9.97 015		60
1	9.55 466	33	9.58 455	37	0.41 545	9.97 010	5	59
2	9.55 499	33	9.58 493	38	0.41 507	9.97 005	5	58
3	9.55 532	33	9.58 531	38	0.41 469	9.97 001	4	57
4	9.55 564	32	9.58 569	38	0.41 431	9.96 996	5	56
5	9.55 597	33	9.58 606	37	0.41 394	9.96 991	5	55
6	9.55 630	33	9.58 644	38	0.41 356	9.96 986	5	54
7	9.55 663	33	9.58 681	37	0.41 319	9.96 981	5	53
8	9.55 695	32	9.58 719	38	0.41 281	9.96 976	5	52
9	9.55 728	33	9.58 757	38	0.41 243	9.96 971	5	51
10	9.55 761	33	9.58 794	37	0.41 206	9.96 966	5	50
11	9.55 793	32	9.58 832	38	0.41 168	9.96 962	4	49
12	9.55 826	33	9.58 869	37	0.41 131	9.96 957	5	48
13	9.55 858	32	9.58 907	38	0.41 093	9.96 952	5	47
14	9.55 891	33	9.58 944	37	0.41 056	9.96 947	5	46
15	9.55 923	32	9.58 981	37	0.41 019	9.96 942	5	45
16	9.55 956	33	9.59 019	38	0.40 981	9.96 937	5	44
17	9.55 988	32	9.59 056	37	0.40 944	9.96 932	5	43
18	9.56 021	33	9.59 094	38	0.40 906	9.96 927	5	42
19	9.56 053	32	9.59 131	37	0.40 869	9.96 922	5	41
20	9.56 085	32	9.59 168	37	0.40 832	9.96 917	5	40
21	9.56 118	33	9.59 205	37	0.40 795	9.96 912	5	39
22	9.56 150	32	9.59 243	38	0.40 757	9.96 907	5	38
23	9.56 182	32	9.59 280	37	0.40 720	9.96 903	4	37
24	9.56 215	33	9.59 317	37	0.40 683	9.96 898	5	36
25	9.56 247	32	9.59 354	37	0.40 646	9.96 893	5	35
26	9.56 279	32	9.59 391	37	0.40 609	9.96 888	5	34
27	9.56 311	32	9.59 429	38	0.40 571	9.96 883	5	33
28	9.56 343	32	9.59 466	37	0.40 534	9.96 878	5	32
29	9.56 375	32	9.59 503	37	0.40 497	9.96 873	5	31
30	9.56 408	33	9.59 540	37	0.40 460	9.96 868	5	30
31	9.56 440	32	9.59 577	37	0.40 423	9.96 863	5	29
32	9.56 472	32	9.59 614	37	0.40 386	9.96 858	5	28
33	9.56 504	32	9.59 651	37	0.40 349	9.96 853	5	27
34	9.56 536	32	9.59 688	37	0.40 312	9.96 848	5	26
35	9.56 568	32	9.59 725	37	0.40 275	9.96 843	5	25
36	9.56 599	31	9.59 762	37	0.40 238	9.96 838	5	24
37	9.56 631	32	9.59 799	37	0.40 201	9.96 833	5	23
38	9.56 663	32	9.59 835	36	0.40 165	9.96 828	5	22
39	9.56 695	32	9.59 872	37	0.40 128	9.96 823	5	21
40	9.56 727	32	9.59 909	37	0.40 091	9.96 818	5	20
41	9.56 759	32	9.59 946	37	0.40 054	9.96 813	5	19
42	9.56 790	31	9.59 983	37	0.40 017	9.96 808	5	18
43	9.56 822	32	9.60 019	36	0.39 981	9.96 803	5	17
44	9.56 854	32	9.60 056	37	0.39 944	9.96 798	5	16
45	9.56 886	32	9.60 093	37	0.39 907	9.96 793	5	15
46	9.56 917	31	9.60 130	37	0.39 870	9.96 788	5	14
47	9.56 949	32	9.60 166	36	0.39 834	9.96 783	5	13
48	9.56 980	31	9.60 203	37	0.39 797	9.96 778	5	12
49	9.57 012	32	9.60 240	37	0.39 760	9.96 772	6	11
50	9.57 044	32	9.60 276	36	0.39 724	9.96 767	5	10
51	9.57 075	31	9.60 313	37	0.39 687	9.96 762	5	9
52	9.57 107	32	9.60 349	36	0.39 651	9.96 757	5	8
53	9.57 138	31	9.60 386	37	0.39 614	9.96 752	5	7
54	9.57 169	31	9.60 422	36	0.39 578	9.96 747	5	6
55	9.57 201	32	9.60 459	37	0.39 541	9.96 742	5	5
56	9.57 232	31	9.60 495	36	0.39 505	9.96 737	5	4
57	9.57 264	32	9.60 532	37	0.39 468	9.96 732	5	3
58	9.57 295	31	9.60 568	36	0.39 432	9.96 727	5	2
59	9.57 326	31	9.60 605	37	0.39 395	9.96 722	5	1
60	9.57 358	32	9.60 641	36	0.39 359	9.96 717	5	0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.			
	38	**37**	**36**
1	0,6	0,6	0,6
2	1,3	1,2	1,2
3	1,9	1,8	1,8
4	2,5	2,5	2,4
5	3,2	3,1	3,0
6	3,8	3,7	3,6
7	4,4	4,3	4,2
8	5,1	4,9	4,8
9	5,7	5,6	5,4
10	6,3	6,2	6,0
20	12,7	12,3	12,0
30	19,0	18,5	18,0
40	25,3	24,7	24,0
50	31,7	30,8	30,0
	33	**32**	**31**
1	0,6	0,5	0,5
2	1,1	1,1	1,0
3	1,6	1,6	1,6
4	2,2	2,1	2,1
5	2,8	2,7	2,6
6	3,3	3,2	3,1
7	3,8	3,7	3,6
8	4,4	4,3	4,1
9	5,0	4,8	4,6
10	5,5	5,3	5,2
20	11,0	10,7	10,3
30	16,5	16,0	15,5
40	22,0	21,3	20,7
50	27,5	26,7	25,8
	6	**5**	**4**
1	0,1	0,1	0,1
2	0,2	0,2	0,1
3	0,3	0,2	0,2
4	0,4	0,3	0,3
5	0,5	0,4	0,3
6	0,6	0,5	0,4
7	0,7	0,6	0,5
8	0,8	0,7	0,5
9	0,9	0,8	0,6
10	1,0	0,8	0,7
20	2,0	1,7	1,3
30	3,0	2,5	2,0
40	4,0	3,3	2,7
50	5,0	4,2	3,3
	6 **37**	**5** **38**	**5** **37**
0	37	38	37
1	3,1	3,8	3,7
2	9,2	11,4	11,1
3	15,4	19,0	18,5
4	21,6	26,6	25,9
5	27,8	34,2	33,3
6	33,9		
	5	**4**	**4**
0	36	38	37
1	3,6	4,8	4,6
2	10,8	14,2	13,9
3	18,0	23,8	23,1
4	25,2	33,2	32,4
5	32,4		
P. P.			

68°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

22°

'	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.57 358		9.60 641		0.39 359	9.96 717		60
1	9.57 389	31	9.60 677	36	0.39 323	9.96 711	6	59
2	9.57 420	31	9.60 714	37	0.39 286	9.96 706	5	58
3	9.57 451	31	9.60 750	36	0.39 250	9.96 701	5	57
4	9.57 482	31	9.60 786	36	0.39 214	9.96 696	5	56
5	9.57 514	32	9.60 823	37	0.39 177	9.96 691	5	55
6	9.57 545	31	9.60 859	36	0.39 141	9.96 686	5	54
7	9.57 576	31	9.60 895	36	0.39 105	9.96 681	5	53
8	9.57 607	31	9.60 931	36	0.39 069	9.96 676	5	52
9	9.57 638	31	9.60 967	36	0.39 033	9.96 670	6	51
10	9.57 669	31	9.61 004	37	0.38 996	9.96 665	5	50
11	9.57 700	31	9.61 040	36	0.38 960	9.96 660	5	49
12	9.57 731	31	9.61 076	36	0.38 924	9.96 655	5	48
13	9.57 762	31	9.61 112	36	0.38 888	9.96 650	5	47
14	9.57 793	31	9.61 148	36	0.38 852	9.96 645	5	46
15	9.57 824	31	9.61 184	36	0.38 816	9.96 640	5	45
16	9.57 855	31	9.61 220	36	0.38 780	9.96 634	6	44
17	9.57 885	30	9.61 256	36	0.38 744	9.96 629	5	43
18	9.57 916	31	9.61 292	36	0.38 708	9.96 624	5	42
19	9.57 947	31	9.61 328	36	0.38 672	9.96 619	5	41
20	9.57 978	31	9.61 364	36	0.38 636	9.96 614	5	40
21	9.58 008	30	9.61 400	36	0.38 600	9.96 608	6	39
22	9.58 039	31	9.61 436	36	0.38 564	9.96 603	5	38
23	9.58 070	31	9.61 472	36	0.38 528	9.96 598	5	37
24	9.58 101	31	9.61 508	36	0.38 492	9.96 593	5	36
25	9.58 131	30	9.61 544	36	0.38 456	9.96 588	5	35
26	9.58 162	31	9.61 579	35	0.38 421	9.96 582	6	34
27	9.58 192	30	9.61 615	36	0.38 385	9.96 577	5	33
28	9.58 223	31	9.61 651	36	0.38 349	9.96 572	5	32
29	9.58 253	30	9.61 687	36	0.38 313	9.96 567	5	31
30	9.58 284	31	9.61 722	35	0.38 278	9.96 562	5	30
31	9.58 314	30	9.61 758	36	0.38 242	9.96 556	6	29
32	9.58 345	31	9.61 794	36	0.38 206	9.96 551	5	28
33	9.58 375	30	9.61 830	36	0.38 170	9.96 546	5	27
34	9.58 406	31	9.61 865	35	0.38 135	9.96 541	5	26
35	9.58 436	30	9.61 901	36	0.38 099	9.96 535	6	25
36	9.58 467	31	9.61 936	35	0.38 064	9.96 530	5	24
37	9.58 497	30	9.61 972	36	0.38 028	9.96 525	5	23
38	9.58 527	30	9.62 008	36	0.37 992	9.96 520	5	22
39	9.58 557	30	9.62 043	35	0.37 957	9.96 514	6	21
40	9.58 588	31	9.62 079	36	0.37 921	9.96 509	5	20
41	9.58 618	30	9.62 114	35	0.37 886	9.96 504	5	19
42	9.58 648	30	9.62 150	36	0.37 850	9.96 498	6	18
43	9.58 678	30	9.62 185	35	0.37 815	9.96 493	5	17
44	9.58 709	31	9.62 221	36	0.37 779	9.96 488	5	16
45	9.58 739	30	9.62 256	35	0.37 744	9.96 483	5	15
46	9.58 769	30	9.62 292	36	0.37 708	9.96 477	6	14
47	9.58 799	30	9.62 327	35	0.37 673	9.96 472	5	13
48	9.58 829	30	9.62 362	35	0.37 638	9.96 467	5	12
49	9.58 859	30	9.62 398	36	0.37 602	9.96 461	6	11
50	9.58 889	30	9.62 433	35	0.37 567	9.96 456	5	10
51	9.58 919	30	9.62 468	35	0.37 532	9.96 451	5	9
52	9.58 949	30	9.62 504	36	0.37 496	9.96 445	6	8
53	9.58 979	30	9.62 539	35	0.37 461	9.96 440	5	7
54	9.59 909	30	9.62 574	35	0.37 426	9.96 435	5	6
55	9.59 039	30	9.62 609	35	0.37 391	9.96 429	6	5
56	9.59 069	30	9.62 645	36	0.37 355	9.96 424	5	4
57	9.59 098	29	9.62 680	35	0.37 320	9.96 419	5	3
58	9.59 128	30	9.62 715	35	0.37 285	9.96 413	6	2
59	9.59 158	30	9.62 750	35	0.37 250	9.96 408	5	1
60	9.59 188	30	9.62 785	35	0.37 215	9.96 403	5	0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	'

P. P.

	37	36	35
1	0,6	0,6	0,6
2	1,2	1,2	1,2
3	1,8	1,8	1,8
4	2,5	2,4	2,3
5	3,1	3,0	2,9
6	3,7	3,6	3,5
7	4,3	4,2	4,1
8	4,9	4,8	4,7
9	5,6	5,4	5,2
10	6,2	6,0	5,8
20	12,3	12,0	11,7
30	18,5	18,0	17,5
40	24,7	24,0	23,3
50	30,8	30,0	29,2

	32	31	30
1	0,5	0,5	0,5
2	1,1	1,0	1,0
3	1,6	1,6	1,5
4	2,1	2,1	2,0
5	2,7	2,6	2,5
6	3,2	3,1	3,0
7	3,7	3,6	3,5
8	4,3	4,1	4,0
9	4,8	4,6	4,5
10	5,3	5,2	5,0
20	10,7	10,3	10,0
30	16,0	25,5	15,0
40	21,3	20,7	20,0
50	26,7	25,8	25,0

	29	6	5
1	0,5	0,1	0,1
2	1,0	0,2	0,2
3	1,4	0,3	0,2
4	1,9	0,4	0,3
5	2,4	0,5	0,4
6	2,9	0,6	0,5
7	3,4	0,7	0,6
8	3,9	0,8	0,7
9	4,4	0,9	0,8
10	4,8	1,0	0,8
20	9,7	2,0	1,7
30	14,5	3,0	2,5
40	19,3	4,0	3,3
50	24,2	5,0	4,2

	6/36	6/35
0	3,0	2,9
1	9,0	8,8
2	15,0	14,6
3	21,0	20,4
4	27,0	26,2
5	33,0	32,1
6		

	5/37	5/36	5/35
0	3,7	3,6	3,5
1	11,1	10,8	10,5
2	18,5	18,0	17,5
3	25,9	25,2	24,5
4	33,3	32,4	31,5
5			

P. P.

67°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

23°

′	L. Sin.	d.	L. Tang.	d. e.	L. Cotg.	L. Cos.	d.	
0	9.59 188		9.62 785		0.37 215	9.96 403		**60**
1	9.59 218	30	9.62 820	35	0.37 180	9.96 397	6	59
2	9.59 247	29	9.62 855	35	0.37 145	9.96 392	5	58
3	9.59 277	30	9.62 890	35	0.37 110	9.96 387	5	57
4	9.59 307	30	9.62 926	36	0.37 074	9.96 381	6	56
5	9.59 336	29	9.62 961	35	0.37 039	9.96 376	5	55
6	9.59 366	30	9.62 996	35	0.37 004	9.96 370	6	54
7	9.59 396	30	9.63 031	35	0.36 969	9.96 365	5	53
8	9.59 425	29	9.63 066	35	0.36 934	9.96 360	5	52
9	9.59 455	30	9.63 101	35	0.36 899	9.96 354	6	51
10	9.59 484	29	9.63 135	34	0.36 865	9.96 349	5	**50**
11	9.59 514	30	9.63 170	35	0.36 830	9.96 343	6	49
12	9.59 543	29	9.63 205	35	0.36 795	9.96 338	5	48
13	9.59 573	30	9.63 240	35	0.36 760	9.96 333	5	47
14	9.59 602	29	9.63 275	35	0.36 725	9.96 327	6	46
15	9.59 632	30	9.63 310	35	0.36 690	9.96 322	5	45
16	9.59 661	29	9.63 345	35	0, 36 655	9.96 316	6	44
17	9.59 690	29	9.63 379	34	0.36 621	9.96 311	5	43
18	9.59 720	30	9.63 414	35	0.36 586	9.96 305	6	42
19	9.59 749	29	9.63 449	35	0.36 551	9.96 300	5	41
20	9.59 778	29	9.63 484	35	0.36 516	9.96 294	6	**40**
21	9.59 808	30	9.63 519	35	0.36 481	9.96 289	5	39
22	9.59 837	29	9.63 553	34	0.36 447	9.96 284	5	38
23	9.59 866	29	9.63 588	35	0.36 412	9.96 278	6	37
24	9.59 895	29	9.63 623	35	0.36 377	9.96 273	5	36
25	9.59 924	29	9.63 657	34	0.36 343	9.96 267	6	35
26	9.59 954	30	9.63 692	35	0.36 308	9.96 262	5	34
27	9.59 983	29	9.63 726	34	0.36 274	9.96 256	6	33
28	9.60 012	29	9.63 761	35	0.36 239	9.96 251	5	32
29	9.60 041	29	9.63 796	35	0.36 204	9.96 245	6	31
30	9.60 070	29	9.63 830	34	0.36 170	9.96 240	5	**30**
31	9.60 099	29	9.63 865	35	0.36 135	9.96 234	6	29
32	9.60 128	29	9.63 899	34	0.36 101	9.96 229	5	28
33	9.60 157	29	9.63 934	35	0.36 066	9.96 223	6	27
34	9.60 186	29	9.63 968	34	0.36 032	9.96 218	5	26
35	9.60 215	29	9.64 003	35	0.35 997	9.96 212	6	25
36	9.60 244	29	9.64 037	34	0.35 963	9.96 207	5	24
37	9.60 273	29	9.64 072	35	0.35 928	9.96 201	6	23
38	9.60 302	29	9.64 106	34	0.35 894	9.96 196	5	22
39	9.60 331	29	9.64 140	34	0.35 860	9.96 190	6	21
40	9.60 359	28	9.64 175	35	0.35 825	9.96 185	5	**20**
41	9.60 388	29	9.64 209	34	0.35 791	9.96 179	6	19
42	9.60 417	29	9.64 243	34	0.35 757	9.96 174	5	18
43	9.60 446	29	9.64 278	35	0.35 722	9.96 168	6	17
44	9.60 474	28	9.64 312	34	0.35 688	9.96 162	6	16
45	9.60 503	29	9.64 346	34	0.35 654	9.96 157	5	15
46	9.60 532	29	9.64 381	35	0.35 619	9.96 151	6	14
47	9.60 561	29	9.64 415	34	0.35 585	9.96 146	5	13
48	9.60 589	28	9.64 449	34	0.35 551	9.96 140	6	12
49	9.60 618	29	9.64 483	34	0.35 517	9.96 135	5	11
50	9.60 646	28	9.64 517	34	0.35 483	9.96 129	6	**10**
51	9.60 675	29	9.64 552	35	0.35 448	9.96 123	6	9
52	9.60 704	29	9.64 586	34	0.35 414	9.96 118	5	8
53	9.60 732	28	9.64 620	34	0.35 380	9.96 112	6	7
54	9.60 761	29	9.64 654	34	0.35 346	9.96 107	5	6
55	9.60 789	28	9.64 688	34	0.35 312	9.96 101	6	5
56	9.60 818	29	9.64 722	34	0.35 278	9.96 095	6	4
57	9.60 846	28.	9.64 756	34	0.35 244	9.96 090	5	3
58	9.60 875	29	9.64 790	34	0.35 210	9.96 084	6	2
59	9.60 903	28	9.64 824	34	0.35 176	9.96 079	5	1
60	9.60 931	28	9.64 858	34	0.35 142	9.96 073	6	**0**
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	36	**35**	**34**
1	0,6	0,6	0,6
2	1,2	1,2	1,1
3	1,8	1,8	1,7
4	2,4	2,3	2,3
5	3,0	2,9	2,8
6	3,6	3,5	3,4
7	4,2	4,1	4,0
8	4,8	4,7	4,5
9	5,4	5,2	5,1
10	6,0	5,8	5,7
20	12,0	11,7	11,3
30	18,0	17,5	17,0
40	24,0	23,3	22,7
50	30,0	29,2	28,3

	30	**29**	**28**
1	0,5	0,5	0,5
2	1,0	1,0	0,9
3	1,5	1,4	1,4
4	2,0	1,9	1,9
5	2,5	2,4	2,3
6	3,0	2,9	2,8
7	3,5	3,4	3,3
8	4,0	3,9	3,7
9	4,5	4,4	4,2
10	5,0	4,8	4,7
20	10,0	9,7	9,3
30	15,0	14,5	14,0
40	20,0	19,3	18,7
50	25,0	24,2	23,3

	6	**5**
1	0,1	0,1
2	0,2	0,2
3	0,3	0,2
4	0,4	0,3
5	0,5	0,4
6	0,6	0,5
7	0,7	0,6
8	0,8	0,7
9	0,9	0,8
10	1,0	0,8
20	2,0	1,7
30	3,0	2,5
40	4,0	3,3
50	5,0	4,2

	$\frac{6}{36}$	$\frac{6}{35}$	$\frac{6}{34}$
0	3,0	2,9	2,8
1	9,0	8,8	8,5
2	15,0	14,6	14,2
3	21,0	20,4	19,8
4	27,0	26,2	25,5
5	33,0	32,1	31,2
6			

	$\frac{5}{35}$	$\frac{5}{34}$
0	3,5	3,4
1	10,5	10,2
2	17,5	17,0
3	24,5	23,8
4	31,5	30,6
5		

P. P.

66°

Table XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

24°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.60 931		9.64 858		0.35 142	9.96 073		60
1	9.60 960	29	9.64 892	34	0.35 108	9.96 067	6	59
2	9.60 988	28	9.64 926	34	0.35 074	9.96 062	5	58
3	9.61 016	28	9.64 960	34	0.35 040	9.96 056	6	57
4	9.61 045	29	9.64 994	34	0.35 006	9.96 050	6	56
5	9.61 073	28	9.65 028	34	0.34 972	9.96 045	5	55
6	9.61 101	28	9.65 062	34	0.34 938	9.96 039	6	54
7	9.61 129	28	9.65 096	34	0.34 904	9.96 034	5	53
8	9.61 158	29	9.65 130	34	0.34 870	9.96 028	6	52
9	9.61 186	28	9.65 164	34	0.34 836	9.96 022	6	51
10	9.61 214	28	9.65 197	33	0.34 803	9.96 017	5	50
11	9.61 242	28	9.65 231	34	0.34 769	9.96 011	6	49
12	9.61 270	28	9.65 265	34	0.34 735	9.96 005	6	48
13	9.61 298	28	9.65 299	34	0.34 701	9.96 000	5	47
14	9.61 326	28	9.65 333	34	0.34 667	9.95 994	6	46
15	9.61 354	28	9.65 366	33	0.34 634	9.95 988	6	45
16	9.61 382	28	9.65 400	34	0.34 600	9.95 982	6	44
17	9.61 411	29	9.65 434	34	0.34 566	9.95 977	5	43
18	9.61 438	27	9.65 467	33	0.34 533	9.95 971	6	42
19	9.61 466	28	9.65 501	34	0.34 499	9.95 965	6	41
20	9.61 494	28	9.65 535	34	0.34 465	9.95 960	5	40
21	9.61 522	28	9.65 568	33	0.34 432	9.95 954	6	39
22	9.61 550	28	9.65 602	34	0.34 398	9.95 948	6	38
23	9.61 578	28	9.65 636	34	0.34 364	9.95 942	6	37
24	9.61 606	28	9.65 669	33	0.34 331	9.96 937	5	36
25	9.61 634	28	9.65 703	34	0.34 297	9.95 931	6	35
26	9.61 662	28	9.65 736	33	0.34 264	9.95 925	6	34
27	9.61 689	27	9.65 770	34	0.34 230	9.95 920	5	33
28	9.61 717	28	9.65 803	33	0.34 197	9.95 914	6	32
29	9.61 745	28	9.65 837	34	0.34 163	9.95 908	6	31
30	9.61 773	28	9.65 870	33	0.34 130	9.95 902	6	30
31	9.61 800	27	9.65 904	34	0.34 096	9.95 897	5	29
32	9.61 828	28	9.65 937	33	0.34 063	9.95 891	6	28
33	9.61 856	28	9.65 971	34	0.34 029	9.95 885	6	27
34	9.61 883	27	9.66 004	33	0.33 996	9.95 879	6	26
35	9.61 911	28	9.66 038	34	0.33 962	9.95 873	6	25
36	9.61 939	28	9.66 071	33	0.33 929	9.95 868	5	24
37	9.61 966	27	9.66 104	33	0.33 896	9.95 862	6	23
38	9.61 994	28	9.66 138	34	0.33 862	9.95 856	6	22
39	9.62 021	27	9.66 171	33	0.33 829	9.95 850	6	21
40	9.62 049	28	9.66 204	33	0.33 796	9.95 844	6	20
41	9.62 076	27	9.66 238	34	0.33 762	9.95 839	5	19
42	9.62 104	28	9.66 271	33	0.33 729	9.95 833	6	18
43	9.62 131	27	9.66 304	33	0.33 696	9.95 827	6	17
44	9.62 159	28	9.66 337	33	0.33 663	9.95 821	6	16
45	9.62 186	27	9.66 371	34	0.33 629	9.95 815	6	15
46	9.62 214	28	9.66 404	33	0.33 596	9.95 810	5	14
47	9.62 241	27	9.66 437	33	0.33 563	9.95 804	6	13
48	9.62 268	27	9.66 470	33	0.33 530	9.95 798	6	12
49	9.62 296	28	9.66 503	33	0.33 497	9.95 792	6	11
50	9.62 323	27	9.66 537	34	0.33 463	9.95 786	6	10
51	9.62 350	27	9.66 570	33	0.33 430	9.95 780	6	9
52	9.62 377	27	9.66 603	33	0.33 397	9.95 775	5	8
53	9.62 405	28	9.66 636	33	0.33 364	9.95 769	6	7
54	9.62 432	27	9.66 669	33	0.33 331	9.95 763	6	6
55	9.62 459	27	9.66 702	33	0.33 298	9.95 757	6	5
56	9.62 486	27	9.66 735	33	0.33 265	9.95 751	6	4
57	9.62 513	27	9.66 768	33	0.33 232	9.95 745	6	3
58	9.62 541	28	9.66 801	33	0.33 199	9.95 739	6	2
59	9.62 568	27	9.66 834	33	0.33 166	9.95 733	6	1
60	9.62 595	27	9.66 867	33	0.33 133	9.95 728	5	0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	34	33
1	0,6	0,6
2	1,1	1,1
3	1,7	1,6
4	2,3	2,2
5	2,8	2,8
6	3,4	3,3
7	4,0	3,8
8	4,5	4,4
9	5,1	5,0
10	5,7	5,5
20	11,3	11,0
30	17,0	16,5
40	22,7	22 0
50	28,3	27,5

	29	28	27
1	0,5	0,5	0,4
2	1,0	0,9	0,9
3	1,4	1,4	1,4
4	1,9	1,9	1,8
5	2'4	2,3	2,2
6	2,9	2,8	2,7
7	3,4	3,3	3,2
8	3,9	3,7	3,6
9	4,4	4,2	4,0
10	4,8	4,7	4,5
20	9,7	9,3	9,0
30	14,5	14,0	13,5
40	19,3	18,7	18,0
50	24,2	23,3	22,5

	6	5
1	0,1	0,1
2	0,2	0,2
3	0,3	0,2
4	0,4	0,3
5	0,5	0,4
6	0,6	0,5
7	0,7	0,6
8	0,8	0,7
9	0,9	0,8
10	1,0	0,8
20	2,0	1,7
30	3,0	2,5
40	4,0	3,3
50	5,0	4,2

	6	6	5
0	34	33	34
1	2,8	2,8	3,4
2	8,5	8,2	10,2
3	14,2	13,8	17,0
4	19,8	19,2	23,8
5	25,5	24,8	30,6
6	31,2	30,2	

P. P.

65°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

25°

'	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.62 595	27	9.66 867	33	0.33 133	9.95 728	6	60
1	9.62 622	27	9.66 900	33	0.33 100	9.95 722	6	59
2	9.62 649	27	9.66 933	33	0.33 067	9.95 716	6	58
3	9.62 676	27	9.66 966	33	0.33 014	9.95 710	6	57
4	9.62 703	27	9.66 999	33	0.33 001	9.95 704	6	56
5	9.62 730	27	9.67 032	33	0.32 968	9.95 698	6	55
6	9.62 757	27	9.67 065	33	0.32 935	9.95 692	6	54
7	9.62 784	27	9.67 098	33	0.32 902	9.95 686	6	53
8	9.62 811	27	9.67 131	32	0.32 869	9.95 680	6	52
9	9.62 838	27	9.67 163	33	0.32 837	9.95 674	6	51
10	9.62 865	27	9.67 196	33	0.32 804	9.95 668	5	50
11	9.62 892	26	9.67 229	33	0.32 771	9.95 663	6	49
12	9.62 918	27	9.67 262	33	0.32 738	9.95 657	6	48
13	9.62 945	27	9.67 295	32	0.32 705	9.95 651	6	47
14	9.62 972	27	9.67 327	33	0.32 673	9.95 645	6	46
15	9.62 999	27	9.67 360	33	0.32 640	9.95 639	6	45
16	9.63 026	26	9.67 393	33	0.32 607	9.95 633	6	44
17	9.63 052	27	9.67 426	32	0.32 574	9.95 627	6	43
18	9.63 079	27	9.67 458	33	0.32 542	9.95 621	6	42
19	9.63 106	27	9.67 491	33	0.32 509	9.95 615	6	41
20	9.63 133	26	9.67 524	32	0.32 476	9 95 609	6	40
21	9.63 159	27	9.67 556	33	0.32 444	9.95 603	6	39
22	9.63 186	27	9.67 589	33	0.32 411	9.95 597	6	38
23	9.63 213	26	9.67 622	32	0.32 378	9.95 591	6	37
24	9.63 239	27	9.67 654	33	0.32 346	9.95 585	6	36
25	9.63 206	26	9.67 687	32	0.32 313	9.95 579	6	35
26	9.63 292	27	9.67 719	33	0.32 281	9.95 573	6	34
27	9.63 319	26	9.67 752	33	0.32 248	9.95 567	6	33
28	9.63 345	27	9.67 785	32	0.32 215	9.95 561	6	32
29	9.63 372	26	9.67 817	33	0.32 183	9.95 555	6	31
30	9.63 398	27	9.67 850	32	0.32 150	9.95 549	6	30
31	9.63 425	26	9.67 882	33	0.32 118	9.95 543	6	29
32	9.63 451	27	9.67 915	32	0.32 085	9.95 537	6	28
33	9.63 478	26	9.67 947	33	0.32 053	9.95 531	6	27
34	9.63 504	27	9.67 980	32	0.32 020	9.95 525	6	26
35	9.63 531	26	9.68 012	32	0.31 988	9.95 519	6	25
36	9.63 557	26	9.68 044	33	0.31 956	9.95 513	6	24
37	9.63 583	27	9.68 077	32	0.31 923	9.95 507	7	23
38	9.63 610	26	9.68 109	33	0.31 891	9.95 500	6	22
39	9.63 636	26	9.68 142	32	0.31 858	9.95 494	6	21
40	9.63 662	27	9.68 174	32	0.31 826	9.95 488	6	20
41	9.63 689	26	9.68 206	33	0.31 794	9.95 482	6	19
42	9.63 715	26	9.68 239	32	0.31 761	9.95 476	6	18
43	9.63 741	26	9.68 271	32	0.31 729	9.95 470	6	17
44	9.63 767	27	9.68 303	33	0.31 697	9.95 464	6	16
45	9.63 794	26	9.68 336	32	0.31 664	9.95 458	6	15
46	9.63 820	26	9.68 368	32	0.31 632	9.95 452	6	14
47	9.63 846	26	9.68 400	32	0.31 600	9.95 446	6	13
48	9.63 872	26	9.68 432	33	0.31 568	9.95 440	6	12
49	9.63 898	26	9.68 465	32	0.31 535	9.95 434	7	11
50	9.63 924	26	9.68 497	32	0.31 503	9.95 427	6	10
51	9.63 950	26	9.68 529	32	0.31 471	9.95 421	6	9
52	9.63 976	26	9.68 561	32	0.31 439	9.95 415	6	8
53	9.64 002	26	9.68 593	33	0.31 407	9.95 409	6	7
54	9.64 028	26	9.68 626	32	0.31 374	9.95 403	6	6
55	9.64 054	26	9.68 658	32	0.31 342	9.95 397	6	5
56	9.64 080	26	9.68 690	32	0.31 310	9.95 391	7	4
57	9.64 106	26	9.68 722	32	0.31 278	9.95 384	6	3
58	9.64 132	26	9.68 754	32	0.31 246	9.95 378	6	2
59	9.64 158	26	9.68 786	32	0.31 214	9.95 372	6	1
60	9.64 184		9.68 818		0.31 182	9.95 366		0
'	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	'

P. P.

	33	32
1	0,6	0,5
2	1,1	1,1
3	1,6	1,6
4	2,2	2,1
5	2,8	2,7
6	3,3	3,2
7	3,8	3,7
8	4,4	4,3
9	5,0	4,8
10	5,5	5,3
20	11,0	10,7
30	16,5	16,0
40	22,0	21,3
50	27,5	26,7

	27	26
1	0,4	0,4
2	0,9	0,9
3	1,4	1,3
4	1,8	1,7
5	2,2	2,2
6	2,7	2,6
7	3,2	3,0
8	3,6	3,5
9	4'0	3,9
10	4,5	4'3
20	9,0	8,7
30	13,5	13,0
40	18,0	17,3
50	22,5	21,7

	7	6	5
1	0,1	0,1	0,1
2	0,2	0,2	0,2
3	0,4	0,3	0,2
4	0,5	0,4	0,3
5	0,6	0,5	0,4
6	0,7	0,6	0,5
7	0,8	0,7	0,6
8	0,9	0,8	0,7
9	1,0	0,9	0,8
10	1,2	1,0	0,8
20	2,3	2,0	1,7
30	3,5	3,0	2,5
40	4,7	4,0	3,3
50	5,8	5,0	4,2

	7/32	6/32	5/33
0			
1	2,3	2,7	3,3
2	6,9	8,0	9,9
3	11,4	13,3	16,5
4	16,0	18,7	23,1
5	20,6	24,0	29,7
6	25,1	29,3	
7	29,7		

P. P.

64°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

26°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.64 184		9.68 818		0.31 182	9.95 366		**60**
1	9.64 210	26	9.68 850	32	0.31 150	9.95 360	6	59
2	9.64 236	26	9.68 882	32	0.31 118	9.95 354	6	58
3	9.64 262	26	9.68 914	32	0.31 086	9.95 348	6	57
4	9.64 288	26	9.68 946	32	0.31 054	9.95 341	7	56
5	9.64 313	25	9.68 978	32	0.31 022	9.95 335	6	55
6	9.64 339	26	9.69 010	32	0.30 990	9.95 329	6	54
7	9.64 365	26	9.69 042	32	0.30 958	9.95 323	6	53
8	9.64 391	26	9.69 074	32	0.30 926	9.95 317	6	52
9	9.64 417	26	9.69 106	32	0.30 894	9.95 310	7	51
10	9.64 442	25	9.69 138	32	0.30 862	9.95 304	6	**50**
11	9.64 468	26	9.69 170	32	0.30 830	9.95 298	6	49
12	9.64 494	26	9.69 202	32	0.30 798	9.95 292	6	48
13	9.64 519	25	9.69 234	32	0.30 766	9.95 286	6	47
14	9.64 545	26	9.69 266	32	0.30 734	9.95 279	7	46
15	9.64 571	26	9.69 298	32	0.30 702	9.95 273	6	45
16	9.64 596	25	9.69 329	31	0.30 671	9.95 267	6	44
17	9.64 622	26	9.69 361	32	0.30 639	9.95 261	6	43
18	9.64 647	25	9.69 393	32	0.30 607	9.95 254	7	42
19	9.64 673	26	9.69 425	32	0.30 575	9.95 248	6	41
20	9.64 698	25	9.69 457	32	0.30 543	9.95 242	6	**40**
21	9.64 724	26	9.69 488	31	0.30 512	9.95 236	6	39
22	9.64 749	25	9.69 520	32	0.30 480	9.95 229	7	38
23	9.64 775	26	9.69 552	32	0.30 448	9.95 223	6	37
24	9.64 800	25	9.69 584	32	0.30 416	9.95 217	6	36
25	9.64 826	26	9.69 615	31	0.30 385	9.95 211	6	35
26	9.64 851	25	9.69 647	32	0.30 353	9.95 204	7	34
27	9.64 877	26	9.69 679	32	0.30 321	9.95 198	6	33
28	9.64 902	25	9.69 710	31	0.30 290	9.95 192	6	32
29	9.64 927	25	9.69 742	32	0.30 258	9.95 185	7	31
30	9.64 953	26	9.69 774	32	0.30 226	9.95 179	6	**30**
31	9.64 978	25	9.69 805	31	0.30 195	9.95 173	6	29
32	9.65 003	25	9.69 837	32	0.30 163	9.95 167	6	28
33	9.65 029	26	9.69 868	31	0.30 132	9.95 160	7	27
34	9.65 054	25	9.69 900	32	0.30 100	9.95 154	6	26
35	9.65 079	25	9.69 932	32	0.30 068	9.95 148	6	25
36	9.65 104	25	9.69 963	31	0.30 037	9.95 141	7	24
37	9.65 130	26	9.69 995	32	0.30 005	9.95 135	6	23
38	9.65 155	25	9.70 026	31	0.29 974	9.95 129	6	22
39	9.65 180	25	9.70 058	32	0.29 942	9.95 122	7	21
40	9.65 205	25	9.70 089	31	0.29 911	9.95 116	6	**20**
41	9.65 230	25	9.70 121	32	0.29 879	9.95 110	6	19
42	9.65 255	25	9.70 152	31	0.29 848	9.95 103	7	18
43	9.65 281	26	9.70 184	32	0.29 816	9.95 097	6	17
44	9.65 306	25	9.70 215	31	0.29 785	9.95 090	7	16
45	9.65 331	25	9.70 247	32	0.29 753	9.95 084	6	15
46	9.65 356	25	9.70 278	31	0.29 722	9.95 078	6	14
47	9.65 381	25	9.70 309	31	0.29 691	9.95 071	7	13
48	9.65 406	25	9.70 341	32	0.29 659	9.95 065	6	12
49	9.65 431	25	9.70 372	31	0.29 628	9.95 059	6	11
50	9.65 456	25	9.70 404	32	0.29 596	9.95 052	7	**10**
51	9.65 481	25	9.70 435	31	0.29 565	9.95 046	6	9
52	9.65 506	25	9.70 466	31	0.29 534	9.95 039	7	8
53	9.65 531	25	9.70 498	32	0.29 502	9.95 033	6	7
54	9.65 556	25	9.70 529	31	0.29 471	9.95 027	6	6
55	9.65 580	24	9.70 560	31	0.29 440	9.95 020	7	5
56	9.65 605	25	9.70 592	32	0.29 408	9.95 014	6	4
57	9.65 630	25	9.70 623	31	0.29 377	9.95 007	7	3
58	9.65 655	25	9.70 654	31	0.29 346	9.95 001	6	2
58	9.65 680	25	9.70 685	31	0.29 315	9 94 995	6	1
60	9.65 705	25	9.70 717	32	0.29 283	9.94 988	7	**0**
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	32	31
1	0,5	0,5
2	1,1	1,0
3	1,6	1,6
4	2,1	2,1
5	2,7	2,6
6	3,2	3,1
7	3,7	3,6
8	4,3	4,1
9	4,8	4,6
10	5,3	5,2
20	10,7	10,3
30	16,0	15,5
40	21,3	20,7
50	26,7	25,8

	26	25	24
1	0,4	0,4	0,4
2	0,9	0,8	0,8
3	1,3	1,2	1,2
4	1,7	1,7	1,6
5	2,2	2,1	2,0
6	2,6	2,5	2,4
7	3,0	2,9	2,8
8	3,5	3,3	3,2
9	3,9	3,8	3,6
10	4,3	4,2	4,0
20	8,7	8,3	8,0
30	13,0	12,5	12,0
40	17,3	16,7	16,0
50	21,7	20,8	20,0

	7	6
1	0,1	0,1
2	0,2	0,2
3	0,4	0,3
4	0,5	0,4
5	0,6	0,5
6	0,7	0,6
7	0,8	0,7
8	0,9	0,8
9	1,0	0,9
10	1,2	1,0
20	2,3	2,0
30	3,5	3,0
40	4,7	4,0
50	5,8	5,0

	7 — 32	7 — 31	6 — 32
0	2,3	2,2	2,7
1	6,9	6,6	8,0
2	11,4	11,1	13,3
3	16,0	15,5	18,7
4	20,6	19,9	24,0
5	25,1	24,4	29,3
6	29,7	28,8	
7			

P. P.

63°

Table XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

27°

'	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.65 705	24	9.70 717	31	0.29 283	9.94 988	6	60
1	9.65 729	25	9.70 748	31	0.29 252	9.94 982	7	59
2	9.65 754	25	9.70 779	31	0.29 221	9.94 975	6	58
3	9.65 779	25	9.70 810	31	0.29 190	9.94 969	7	57
4	9.65 804	24	9.70 841	32	0.29 159	9.94 962	6	56
5	9.65 828	25	9.70 873	31	0.29 127	9.94 956	7	55
6	9.65 853	25	9.70 904	31	0.29 096	9.94 949	6	54
7	9.65 878	24	9.70 935	31	0.29 065	9.94 943	7	53
8	9.65 902	25	9.70 966	31	0.29 034	9.94 936	6	52
9	9.65 927	25	9.70 997	31	0.29 003	9.94 930	7	51
10	9.65 952	24	9.71 028	31	0.28 972	9.94 923	6	50
11	9.65 976	25	9.71 059	31	0.28 941	9.94 917	6	49
12	9.66 001	24	9.71 090	31	0.28 910	9.94 911	7	48
13	9.66 025	25	9.71 121	32	0.28 879	9.94 904	6	47
14	9.66 050	25	9.71 153	31	0.28 847	9.94 898	7	46
15	9.66 075	24	9.71 184	31	0.28 816	9.94 891	6	45
16	9.66 099	25	9.71 215	31	0.28 785	9.94 885	7	44
17	9.66 124	24	9.71 246	31	0.28 754	9.94 878	7	43
18	9.66 148	25	9.71 277	31	0.28 723	9.94 871	6	42
19	9.66 173	24	9.71 308	31	0.28 692	9.94 865	7	41
20	9.66 197	24	9.71 339	31	0.28 661	9.94 858	6	40
21	9.66 221	25	9.71 370	31	0.28 630	9.94 852	7	39
22	9.66 246	24	9.71 401	30	0.28 599	9.94 845	6	38
23	9.66 270	25	9.71 431	31	0.28 569	9.94 839	7	37
24	9.66 295	24	9.71 462	31	0.28 538	9.94 832	6	36
25	9.66 319	24	9.71 493	31	0.28 507	9.94 826	7	35
26	9.66 343	25	9.71 524	31	0.28 476	9.94 819	6	34
27	9.66 368	24	9.71 555	31	0.28 445	9.94 813	7	33
28	9.66 392	24	9.71 586	31	0.28 414	9.94 806	7	32
29	9.66 416	25	9.71 617	31	0.28 383	9.94 799	6	31
30	9.66 441	24	9.71 648	31	0.28 352	9.94 793	7	30
31	9.66 465	24	9.71 679	30	0.28 321	9.94 786	6	29
32	9.66 489	24	9.71 709	31	0.28 291	9.94 780	7	28
33	9.66 513	24	9.71 740	31	0.28 260	9.94 773	6	27
34	9.66 537	25	9.71 771	31	0.28 229	9.94 767	7	26
35	9.66 562	24	9.71 802	31	0.28 198	9.94 760	7	25
36	9.66 586	24	9.71 833	30	0.28 167	9.94 753	6	24
37	9.66 610	24	9.71 863	31	0.28 137	9.94 747	7	23
38	9.66 634	24	9.71 894	31	0.28 106	9.94 740	6	22
39	9.66 658	24	9.71 925	30	0.28 075	9.94 734	7	21
40	9.66 682	24	9.71 955	31	0.28 045	9.94 727	7	20
41	9.66 706	25	9.71 986	31	0.28 014	9.94 720	6	19
42	9.66 731	24	9.72 017	31	0.27 983	9.94 714	7	18
43	9.66 755	24	9.72 048	30	0.27 952	9.94 707	7	17
44	9.66 779	24	9.72 078	31	0.27 922	9.94 700	6	16
45	9.66 803	24	9.72 109	31	0.27 891	9.94 694	7	15
46	9.66 827	24	9.72 140	30	0.27 860	9.94 687	7	14
47	9.66 851	24	9.72 170	31	0.27 830	9.94 680	6	13
48	9.66 875	24	9.72 201	30	0.27 799	9.94 674	7	12
49	9.66 899	23	9.72 231	31	0.27 769	9.94 667	7	11
50	9.66 922	24	9.72 262	31	0.27 738	9.94 660	6	10
51	9.66 946	24	9.72 293	30	0.27 707	9.94 654	7	9
52	9.66 970	24	9.72 323	31	0.27 677	9.94 647	7	8
53	9.66 994	24	9.72 354	30	0.27 646	9.94 640	6	7
54	9.67 018	24	9.72 384	31	0.27 616	9.94 634	7	6
55	9.67 042	24	9.72 415	30	0.27 585	9.94 627	7	5
56	9.67 066	24	9.72 445	31	0.27 555	9.94 620	6	4
57	9.67 090	23	9.72 476	30	0.27 524	9.94 614	7	3
58	9.67 113	24	9.72 506	31	0.27 494	9.94 607	7	2
59	9.67 137	24	9.72 537	30	0.27 463	9.94 600	7	1
60	9.67 161		9.72 567		0.27 433	9.94 593		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	'

P. P.

	32	31	30
1	0,5	0,5	0,5
2	1,1	1,0	1,0
3	1,6	1,6	1,5
4	2,1	2,1	2,0
5	2,7	2,6	2,5
6	3,2	3,1	3,0
7	3,7	3,6	3,5
8	4,3	4,1	4,0
9	4,8	4,6	4,5
10	5,3	5,2	5,0
20	10,7	10,3	10,0
30	16,0	15,5	15,0
40	21,3	20,7	20,0
50	26,7	25,8	25,0

	25	24	23
1	0,4	0,4	0,4
2	0,8	0,8	0,8
3	1,2	1,2	1,2
4	1,7	1,6	1,5
5	2,1	2,0	1,9
6	2,5	2,4	2,3
7	2,9	2,8	2,7
8	3,3	3,2	3,1
9	3,8	3,6	3,4
10	4,2	4,0	3,8
20	8,3	8,0	7,7
30	12,5	12,0	11,5
40	16,7	16,0	15,3
50	20,8	20,0	19,2

	7	6
1	0,1	0,1
2	0,2	0,2
3	0,4	0,3
4	0,5	0,4
5	0,6	0,5
6	0,7	0,6
7	0,8	0,7
8	0,9	0,8
9	1,0	0,9
10	1,2	1,0
20	2,3	2,0
30	3,5	3,0
40	4,7	4,0
50	5,8	5,0

	$\frac{7}{30}$	$\frac{6}{31}$	$\frac{6}{30}$
0	2,1	2,6	2,5
1	6,4	7,8	7,5
2	10,7	12,9	12,5
3	15,0	18,1	17,5
4	19,3	23,2	22,5
5	23,6	28,4	27,5
6	27,9		
7			

P. P.

62°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

28°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.67 161	24	9.72 567	31	0.27 433	9.94 593	6	60
1	9.67 185	23	9.72 598	30	0.27 402	9.94 587	7	59
2	9.67 208	24	9.72 628	31	0.27 372	9.94 580	7	58
3	9.67 232	24	9.72 659	30	0.27 341	9.94 573	6	57
4	9.67 256	24	9.72 689	31	0.27 311	9.94 567	7	56
5	9.67 280	23	9.72 720	30	0.27 280	9.94 560	7	55
6	9.67 303	24	9.72 750	30	0.27 250	9.94 553	7	54
7	9.67 327	23	9.72 780	31	0.27 220	9.94 546	6	53
8	9.67 350	24	9.72 811	30	0.27 189	9.94 540	7	52
9	9.67 374	24	9.72 841	31	0.27 159	9.94 533	7	51
10	9.67 398	23	9.72 872	30	0.27 128	9.94 526	7	**50**
11	9.67 421	24	9.72 902	30	0.27 098	9.94 519	6	49
12	9.67 445	23	9.72 932	31	0.27 068	9.94 513	7	48
13	9.67 468	24	9.72 963	30	0.27 037	9.94 506	7	47
14	9.67 492	23	9.72 993	30	0.27 007	9.94 499	7	46
15	9.67 515	24	9.73 023	31	0.26 977	9.94 492	7	45
16	9.67 539	23	9.73 054	30	0.26 946	9.94 485	6	44
17	9.67 562	24	9.73 084	30	0.26 916	9.94 479	7	43
18	9.67 586	23	9.73 114	30	0.26 886	9.94 472	7	42
19	9.67 609	24	9.73 144	31	0.26 856	9.94 465	7	41
20	9.67 633	23	9.73 175	30	0.26 825	9.94 458	7	**40**
21	9.67 656	24	9.73 205	30	0.26 795	9.94 451	6	39
22	9.67 680	23	9.73 235	30	0.26 765	9.94 445	7	38
23	9.67 703	23	9.73 265	30	0.26 735	9.94 438	7	37
24	9.67 726	24	9.73 295	31	0.26 705	9.94 431	7	36
25	9.67 750	23	9.73 326	30	0.26 674	9.94 424	7	35
26	9.67 773	23	9.73 356	30	0.26 644	9.94 417	7	34
27	9.67 796	24	9.73 386	30	0.26 614	9.94 410	6	33
28	9.67 820	23	9.73 416	30	0.26 584	9.94 404	7	32
29	9.67 843	23	9.73 446	30	0.26 554	9.94 397	7	31
30	9.67 866	24	9.73 476	31	0.26 524	9.94 390	7	**30**
31	9.67 890	23	9.73 507	30	0.26 493	9.94 383	7	29
32	9.67 913	23	9.73 537	30	0.26 463	9.94 376	7	28
33	9.67 936	23	9.73 567	30	0.26 433	9.94 369	7	27
34	9.67 959	23	9.73 597	30	0.26 403	9.94 362	7	26
35	9.67 982	24	9.73 627	30	0.26 373	9.94 355	6	25
36	9.68 006	23	9.73 657	30	0.26 343	9.94 349	7	24
37	9.68 029	23	9.73 687	30	0.26 313	9.94 342	7	23
38	9.68 052	23	9.73 717	30	0.26 283	9.94 335	7	22
39	9.68 075	23	9.73 747	30	0.26 253	9.94 328	7	21
40	9.68 098	23	9.73 777	30	0.26 223	9.94 321	7	**20**
41	9.68 121	23	9.73 807	30	0.26 193	9.94 314	7	19
42	9.68 144	23	9.73 837	30	0.26 163	9.94 307	7	18
43	9.68 167	23	9.73 867	30	0.26 133	9.94 300	7	17
44	9.68 190	23	9.73 897	30	0.26 103	9.94 293	7	16
45	9.68 213	24	9.73 927	30	0.26 073	9.94 286	7	15
46	9.68 237	23	9.73 957	30	0.26 043	9.94 279	6	14
47	9.68 260	23	9.73 987	30	0.26 013	9.94 273	7	13
48	9.68 283	22	9.74 017	30	0.25 983	9.94 266	7	12
49	9.68 305	23	9.74 047	30	0.25 953	9.94 259	7	11
50	9.68 328	23	9.74 077	30	0.25 923	9.94 252	7	**10**
51	9.68 351	23	9.74 107	30	0.25 893	9.94 245	7	9
52	9.68 374	23	9.74 137	29	0.25 863	9.94 238	7	8
53	9.68 397	23	9.74 166	30	0.25 834	9.94 231	7	7
54	9.68 420	23	9.74 196	30	0.25 804	9.94 224	7	6
55	9.68 443	23	9.74 226	30	0.25 774	9.94 217	7	5
56	9.68 466	23	9.74 256	30	0.25 744	9.94 210	7	4
57	9.68 489	23	9.74 286	30	0.25 714	9.94 203	7	3
58	9.68 512	22	9.74 316	29	0.25 684	9.94 196	7	2
59	9.68 534	23	9.74 345	30	0.25 655	9.94 189	7	1
60	9.68 557		9.74 375		0.25 625	9.94 182		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	31	30	29
1	0,5	0,5	0,5
2	1,0	1,0	1,0
3	1,6	1,5	1,4
4	2,1	2,0	1,9
5	2,6	2,5	2,4
6	3,1	3,0	2,9
7	3,6	3,5	3,4
8	4,1	4,0	3,9
9	4,6	4,5	4,4
10	5,2	5,0	4,8
20	10,3	10,0	9,7
30	15,5	15,0	14,5
40	20,7	20,0	19,3
50	25,8	25,0	24,2

	24	23	22
1	0,4	0,4	0,4
2	0,8	0,8	0,7
3	1,2	1,2	1,1
4	1,6	1,5	1,5
5	2,0	1,9	1,8
6	2,4	2,3	2,2
7	2,8	2,7	2,6
8	3,2	3,1	2,9
9	3,6	3,4	3,3
10	4,0	3,8	3,7
20	8,0	7,7	7,3
30	12,0	11,5	11,0
40	16,0	15,3	14,7
50	20,0	19,2	18,3

	7	6
1	0,1	0,1
2	0,2	0,2
3	0,4	0,3
4	0,5	0,4
5	0,6	0,5
6	0,7	0,6
7	0,8	0,7
8	0,9	0,8
9	1,0	0,9
10	1,2	1,0
20	2,3	2,0
30	3,5	3,0
40	4,7	4,0
50	5,8	5,0

	$\frac{7}{31}$	$\frac{6}{31}$	$\frac{6}{30}$
0			
1	2,2	2,6	2,5
2	6,6	7,8	7,5
3	11,1	12,9	12,5
4	15,5	18,1	17,5
5	19,9	23,2	22,5
6	24,4	28,4	27,5
7	28,8		

P. P.

61°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

29°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.68 557	23	9.74 375	30	0.25 625	9.94 182	7	60
1	9.68 580	23	9.74 405	30	0.25 595	9.94 175	7	59
2	9.68 603	22	9.74 435	30	0.25 565	9.94 168	7	58
3	9.68 625	23	9.74 465	29	0.25 535	9.94 161	7	57
4	9.68 648	23	9.74 494	30	0.25 506	9.94 154	7	56
5	9.68 671	23	9.74 524	30	0.25 476	9.94 147	7	55
6	9.68 694	22	9.74 554	29	0.25 446	9.94 140	7	54
7	9.68 716	23	9.74 583	30	0.25 417	9.94 133	7	53
8	9.68 739	23	9.74 613	30	0.25 387	9.94 126	7	52
9	9.68 762	22	9.74 643	30	0.25 357	9.94 119	7	51
10	9.68 784	23	9.74 673	29	0.25 327	9.94 112	7	50
11	9.68 807	22	9.74 702	30	0.25 298	9.94 105	7	49
12	9.68 829	23	9.74 732	30	0.25 268	9.94 098	8	48
13	9.68 852	23	9.74 762	29	0.25 238	9.94 090	7	47
14	9.68 875	22	9.74 791	30	0.25 209	9.94 083	7	46
15	9.68 897	23	9.74 821	30	0.25 179	9.94 076	7	45
16	9.68 920	22	9.74 851	29	0.25 149	9.94 069	7	44
17	9.68 942	23	9.74 880	30	0.25 120	9.94 062	7	43
18	9.68 965	22	9.74 910	29	0.25 090	9.94 055	7	42
19	9.68 987	23	9.74 939	30	0.25 061	9.94 048	7	41
20	9.69 010	22	9.74 969	29	0.25 031	9.94 041	7	40
21	9.69 032	23	9.74 998	30	0.25 002	9.94 034	7	39
22	9.69 055	22	9.75 028	30	0.24 972	9.94 027	7	38
23	9.69 077	23	9.75 058	29	0.24 942	9.94 020	8	37
24	9.69 100	22	9.75 087	30	0.24 913	9.94 012	7	36
25	9.69 122	22	9.75 117	29	0.24 883	9.94 005	7	35
26	9.69 144	23	9.75 146	30	0.24 854	9.93 998	7	34
27	9.69 167	22	9.75 176	29	0.24 824	9.93 991	7	33
28	9.69 189	23	9.75 205	30	0.24 795	9.93 984	7	32
29	9.69 212	22	9.75 235	29	0.24 765	9.93 977	7	31
30	9.69 234	22	9.75 264	30	0.24 736	9.93 970	7	30
31	9.69 256	23	9.75 294	29	0.24 706	9.93 963	8	29
32	9.69 279	22	9.75 323	30	0.24 677	9.93 955	7	28
33	9.69 301	22	9.75 353	29	0.24 647	9.93 948	7	27
34	9.69 323	22	9.75 382	29	0.24 618	9.93 941	7	26
35	9.69 345	23	9.75 411	30	0.24 589	9.93 934	7	25
36	9.69 368	22	9.75 441	29	0.24 559	9.93 927	7	24
37	9 69 390	22	9.75 470	30	0.24 530	9.93 920	8	23
38	9.69 412	22	9.75 500	29	0.24 500	9.93 912	7	22
39	9.69 434	22	9.75 529	29	0.24 471	9.93 905	7	21
40	9.69 456	23	9.75 558	30	0.24 442	9.93 898	7	20
41	9.69 479	22	9.75 588	29	0.24 412	9.93 891	7	19
42	9.69 501	22	9.75 617	30	0.24 383	9.93 884	8	18
43	9.69 523	22	9.75 647	29	0.24 353	9.93 876	7	17
44	9.69 545	22	9.75 676	29	0.24 324	9.93 869	7	16
45	9.69 567	22	9.75 705	30	0.24 295	9.93 862	7	15
46	9.69 589	22	9.75 735	29	0.24 265	9.93 855	8	14
47	9.69 611	22	9.75 764	29	0.24 236	9.93 847	7	13
48	9.69 633	22	9.75 793	29	0.24 207	9.93 840	7	12
49	9.69 655	22	9.75 822	30	0.24 178	9.93 833	7	11
50	9.69 677	22	9.75 852	29	0.24 148	9.93 826	7	10
51	9.69 699	22	9.75 881	29	0.24 119	9.93 819	8	9
52	9.69 721	22	9.75 910	29	0.24 090	9.93 811	7	8
53	9.69 743	22	9.75 939	30	0.24 061	9.93 804	7	7
54	9.69 765	22	9.75 969	29	0.24 031	9.93 797	8	6
55	9.69 787	22	9.75 998	29	0.24 002	9.93 789	7	5
56	9.69 809	22	9.76 027	29	0.23 973	9.93 782	7	4
57	9.69 831	22	9.76 056	30	0.23 944	9.93 775	7	3
58	9.69 853	22	9.76 086	29	0.23 914	9.93 768	8	2
59	9.69 875	22	9.76 115	29	0.23 885	9.93 760	7	1
60	9.69 897		9.76 144		0.23 856	9.93 753		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	30	29	23
1	0,5	0,5	0,4
2	1,0	1,0	0,8
3	1,5	1,4	1,2
4	2,0	1,9	1,5
5	2,5	2,4	1,9
6	3,0	2,9	2,3
7	3,5	3,4	2,7
8	4,0	3,9	3,1
9	4,5	4,4	3,4
10	5,0	4,8	3,8
20	10,0	9,7	7,7
30	15,0	14,5	11,5
40	20,0	19,3	15,3
50	25,0	24,2	19,2

	22	8	7
1	0,4	0,1	0,1
2	0,7	0,3	0,2
3	1,1	0,4	0,4
4	1,5	0,5	0,5
5	1,8	0,7	0,6
6	2,2	0,8	0,7
7	2,6	0,9	0,8
8	2,9	1,1	0,9
9	3,3	1,2	1,0
10	3,7	1,3	1,2
20	7,3	2,7	2,3
30	11,0	4,0	3,5
40	14,7	5,3	4,7
50	18,3	6,7	5,8

	$\frac{8}{30}$	$\frac{8}{29}$
0	1,9	1,8
1	5,6	5,4
2	9,4	9,1
3	13,1	12,7
4	16,9	16,3
5	20,6	19,9
6	24,4	23,6
7	28,1	27,2
8		

	$\frac{7}{30}$	$\frac{7}{29}$
0	2,1	2,1
1	6,4	6,2
2	10,7	10,4
3	15,0	14,5
4	19,3	18,6
5	23,6	22,8
6	27,9	26,9
7		

P. P.

60°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

30°

'	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.69 897	22	9.76 144	29	0.23 856	9.93 753	7	60
1	9.69 919	22	9.76 173	29	0.23 827	9.93 746	8	59
2	9.69 941	22	9.76 202	29	0.23 798	9.93 738	7	58
3	9.69 963	21	9.76 231	30	0.23 769	9.93 731	7	57
4	9.69 984	22	9.76 261	29	0.23 739	9.93 724	7	56
5	9.70 006	22	9.76 290	29	0.23 710	9.93 717	8	55
6	9.70 028	22	9.76 319	29	0.23 681	9.93 709	7	54
7	9.70 050	22	9.76 348	29	0.23 652	9.93 702	7	53
8	9.70 072	21	9.76 377	29	0.23 623	9.93 695	8	52
9	9.70 093	22	9.76 406	29	0.23 594	9.93 687	7	51
10	9.70 115	22	9.76 435	29	0.23 565	9.93 680	7	50
11	9.70 137	22	9.76 464	29	0.23 536	9.93 673	8	49
12	9.70 159	21	9.76 493	29	0.23 507	9.93 665	7	48
13	9.70 189	22	9.76 522	29	0.23 478	9.93 658	8	47
14	9.70 202	22	9.76 551	29	0.23 449	9.93 650	7	46
15	9.70 224	21	9.76 580	29	0.23 420	9.93 643	7	45
16	9.70 245	22	9.76 609	30	0.23 391	9.93 636	8	44
17	9.70 267	21	9.76 639	29	0.23 361	9.93 628	7	43
18	9.70 288	22	9.76 668	29	0.23 332	9.93 621	7	42
19	9.70 310	22	9.76 697	28	0.23 303	9.93 614	8	41
20	9.70 332	21	9.76 725	29	0.23 275	9.93 606	7	40
21	9.70 353	22	9.76 754	29	0.23 246	9.93 599	8	39
22	9.70 375	21	9.76 783	29	0.23 217	9.93 591	7	38
23	9.70 396	22	9.76 812	29	0.23 188	9.93 584	7	37
24	9.70 418	21	9.76 841	29	0.23 159	9.93 577	8	36
25	9.70 439	22	9.76 870	29	0.23 130	9.93 569	7	35
26	9.70 461	21	9.76 899	29	0.23 101	9.93 562	8	34
27	9.70 482	22	9.76 928	29	0.23 072	9.93 554	7	33
28	9.70 504	21	9.76 957	29	0.23 043	9.93 547	8	32
29	9.70 525	22	9.76 986	29	0.23 014	9.93 539	7	31
30	9.70 547	21	9.77 015	29	0.22 985	9.93 532	7	30
31	9.70 568	22	9.77 044	29	0.22 956	9.93 525	8	29
32	9.70 590	21	9.77 073	28	0.22 927	9.93 517	7	28
33	9.70 611	22	9.77 101	29	0.22 899	9.93 510	8	27
34	9.70 633	21	9.77 130	29	0.22 870	9.93 502	7	26
35	9.70 654	21	9.77 159	29	0.22 841	9.93 495	8	25
36	9.70 675	22	9.77 188	29	0.22 812	9.93 487	7	24
37	9.70 697	21	9.77 217	29	0.22 783	9.93 480	8	23
38	9.70 718	21	9.77 246	28	0.22 754	9.93 472	7	22
39	9.70 739	22	9.77 274	29	0.22 726	9.93 465	8	21
40	9.70 761	21	9.77 303	29	0.22 697	9.93 457	7	20
41	9.70 782	21	9.77 332	29	0.22 668	9.93 450	8	19
42	9.70 803	21	9.77 361	29	0.22 639	9.93 442	7	18
43	9.70 824	22	9.77 390	28	0.22 610	9.93 435	8	17
44	9.70 846	21	9.77 418	29	0.22 582	9.93 427	7	16
45	9.70 867	21	9.77 447	29	0.22 553	9.93 420	8	15
46	9.70 888	21	9.77 476	29	0.22 524	9.93 412	7	14
47	9.70 909	22	9.77 505	28	0.22 495	9.93 405	8	13
48	9.70 931	21	9.77 533	29	0.22 467	9.93 397	7	12
49	9.70 952	21	9.77 562	29	0.22 438	9.93 390	8	11
50	9.70 973	21	9.77 591	28	0.22 409	9.93 382	7	10
51	9.70 994	21	9.77 619	29	0.22 381	9.93 375	8	9
52	9.71 015	21	9.77 648	29	0.22 352	9.93 367	7	8
53	9.71 036	22	9.77 677	29	0.22 323	9.93 360	8	7
54	9.71 058	21	9.77 706	28	0.22 294	9.93 352	8	6
55	9.71 079	21	9.77 734	29	0.22 266	9.93 344	7	5
56	9.71 100	21	9.77 763	28	0.22 237	9.93 337	8	4
57	9.71 121	21	9.77 791	29	0.22 209	9.93 329	7	3
58	9.71 142	21	9.77 820	29	0.22 180	9.93 322	8	2
59	9.71 163	21	9.77 849	28	0.22 151	9.93 314	7	1
60	9.71 184		9.77 877		0.22 123	9.93 307		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	'

P. P.

	30	29	28
1	0,5	0,5	0,5
2	1,0	1,0	0,9
3	1,5	1,4	1,4
4	2,0	1,9	1,9
5	2,5	2,4	2,3
6	3,0	2,9	2,8
7	3,5	3,4	3,3
8	4,0	3,9	3,7
9	4,5	4,4	4,2
10	5,0	4,8	4,7
20	10,0	9,7	9,3
30	15,0	14,5	14,0
40	20,0	19,3	18,7
50	25,0	24,2	23,3

	22	21
1	0,4	0,4
2	0,7	0,7
3	1,1	1,0
4	1,5	1,4
5	1,8	1,8
6	2,2	2,1
7	2,6	2,4
8	2,9	2,8
9	3,3	3,2
10	3,7	3,5
20	7,3	7,0
30	11,0	10,5
40	14,7	14,0
50	18,3	17,5

	8	7
1	0,1	0,1
2	0,3	0,2
3	0,4	0,4
4	0,5	0,5
5	0,7	0,6
6	0,8	0,7
7	0,9	0,8
8	1,1	0,9
9	1,2	1,0
10	1,3	1,2
20	2,7	2,3
30	4,0	3,5
40	5,3	4,7
50	6,7	5,8

	7 30	7 29	7 28
0	2,1	2,1	2,0
1	6,4	6,2	6,0
2	10,7	10,4	10,0
3	15,0	14,5	14,0
4	19,3	18,6	18,0
5	23,6	22,8	22,0
6	27,9	26,9	26,0
7			

P. P.

59°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

31°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.71 184		9.77 877		0.22 123	9.93 307		60
1	9.71 205	21	9.77 906	29	0.22 094	9.93 299	8	59
2	9.71 226	21	9.77 935	29	0.22 065	9.93 291	8	58
3	9.71 247	21	9.77 963	28	0.22 037	9.93 284	7	57
4	9.71 268	21	9.77 992	29	0.22 008	9.93 276	8	56
5	9.71 289	21	9.78 020	28	0.21 980	9.93 269	7	55
6	9.71 310	21	9.78 049	29	0.21 951	9.93 261	8	54
7	9.71 331	21	9.78 077	28	0.21 923	9.93 253	8	53
8	9.71 352	21	9.78 106	29	0.21 894	9.93 246	7	52
9	9.71 373	21	9.78 135	29	0.21 865	9.93 238	8	51
10	9.71 393	20	9.78 163	28	0.21 837	9.93 230	8	50
11	9.71 414	21	9.78 192	29	0.21 808	9.93 223	7	49
12	9.71 435	21	9.78 220	28	0.21 780	9.93 215	8	48
13	9.71 456	21	9.78 249	29	0.21 751	9.93 207	8	47
14	9.71 477	21	9.78 277	28	0.21 723	9.93 200	7	46
15	9.71 498	21	9.78 306	29	0.21 694	9.93 192	8	45
16	9.71 519	21	9.78 334	28	0.21 666	9.93 184	8	44
17	9.71 539	20	9.78 363	29	0.21 637	9.93 177	7	43
18	9.71 560	21	9.78 391	28	0.21 609	9.93 169	8	42
19	9.71 581	21	9.78 419	28	0.21 581	9.93 161	8	41
20	9.71 602	21	9.78 448	29	0.21 552	9.93 154	7	40
21	9.71 622	20	9.78 476	28	0.21 524	9.93 146	8	39
22	9.71 643	21	9.78 505	29	0.21 495	9.93 138	8	38
23	9.71 664	21	9.78 533	28	0.21 467	9.93 131	7	37
24	9.71 685	21	9.78 562	29	0.21 438	9.93 123	8	36
25	9.71 705	20	9.78 590	28	0.21 410	9.93 115	8	35
26	9.71 726	21	9.78 618	28	0.21 382	9.93 108	7	34
27	9.71 747	21	9.78 647	29	0.21 353	9.93 100	8	33
28	9.71 767	20	9.78 675	28	0.21 325	9.93 092	8	32
29	9.71 788	21	9.78 704	29	0.21 296	9.93 084	8	31
30	9.71 809	21	9.78 732	28	0.21 268	9.93 077	7	30
31	9.71 829	20	9.78 760	28	0.21 240	9.93 069	8	29
32	9.71 850	21	9.78 789	29	0.21 211	9.93 061	8	28
33	9.71 870	20	9.78 817	28	0.21 183	9.93 053	8	27
34	9.71 891	21	9.78 845	28	0.21 155	9.93 046	7	26
35	9.71 911	20	9.78 874	29	0.21 126	9.93 038	8	25
36	9.71 932	21	9.78 902	28	0.21 098	9.93 030	8	24
37	9.71 952	20	9.78 930	28	0.21 070	9.93 022	8	23
38	9.71 973	21	9.78 959	29	0.21 041	9.93 014	8	22
39	9.71 994	21	9.78 987	28	0.21 013	9.93 007	7	21
40	9.72 014	20	9.79 015	28	0.20 985	9.92 999	8	20
41	9.72 034	20	9.79 043	28	0.20 957	9.92 991	8	19
42	9.72 055	21	9.79 072	29	0.20 928	9.92 983	8	18
43	9.72 075	20	9.79 100	28	0.20 900	9.92 976	7	17
44	9.72 096	21	9.79 128	28	0.20 872	9.92 968	8	16
45	9.72 116	20	9.79 156	28	0.20 844	9.92 960	8	15
46	9.72 137	21	9.79 185	29	0.20 815	9.92 952	8	14
47	9.72 157	20	9.79 213	28	0.20 787	9.92 944	8	13
48	9.72 177	20	9.79 241	28	0.20 759	9.92 936	8	12
49	9.72 198	21	9.79 269	28	0.20 731	9.92 929	7	11
50	9.72 218	20	9.79 297	28	0.20 703	9.92 921	8	10
51	9.72 238	20	9.79 326	29	0.20 674	9.92 913	8	9
52	9.72 259	21	9.79 354	28	0.20 646	9.92 905	8	8
53	9.72 279	20	9.79 382	28	0.20 618	9.92 897	8	7
54	9.72 299	20	9.79 410	28	0.20 590	9.92 889	8	6
55	9.72 320	21	9.79 438	28	0.20 562	9.92 881	8	5
56	9.72 340	20	9.79 466	28	0.20 534	9.92 874	7	4
57	9.72 360	20	9.79 495	29	0.20 505	9.92 866	8	3
58	9.72 381	21	9.79 523	28	0.20 477	9.92 858	8	2
59	9.72 401	20	9.79 551	28	0.20 449	9.92 850	8	1
60	9.72 421	20	9.79 579	28	0.20 421	9.92 842	8	0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	29	28
1	0,5	0,5
2	1,0	0,9
3	1,4	1,4
4	1,9	1,9
5	2,4	2,3
6	2,9	2,8
7	3,4	3,3
8	3,9	3,7
9	4,4	4,2
10	4,8	4,7
20	9,7	9,3
30	14,5	14,0
40	19,3	18,7
50	24,2	23,3

	21	20
1	0,4	0,3
2	0,7	0,7
3	1,0	1,0
4	1,4	1,3
5	1,8	1,7
6	2,1	2,0
7	2,4	2,3
8	2,8	2,7
9	3,2	3,0
10	3'5	3,3
20	7,0	6,7
30	10,5	10,0
40	14,0	13,3
50	17,5	16,7

	8	7
1	0,1	0,1
2	0,3	0,2
3	0,4	0,4
4	0,5	0,5
5	0,7	0,6
6	0,8	0,7
7	0,9	0,8
8	1,1	0,9
9	1,2	1,0
10	1,3	1,2
20	2,7	2,3
30	4,0	3,5
40	5,3	4,7
50	6,7	5,8

	$\frac{8}{30}$	$\frac{8}{29}$	$\frac{8}{28}$
0			
1	1,9	1,8	1,8
2	5,6	5,4	5,2
3	9,4	9,1	8,8
4	13,1	12,7	12,2
5	16,9	16,3	15,8
6	20,6	19,9	19,2
7	24,4	23,6	22,8
8	28,1	27,2	26,2

P. P.

58°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

32°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.72 421	20	9.79 579	28	0.20 421	9.92 842	8	60
1	9.72 441	20	9.79 607	28	0.20 393	9.92 834	8	59
2	9.72 461	21	9.79 635	28	0.20 365	9.92 826	8	58
3	9.72 482	20	9.79 663	28	0.20 337	9.92 818	8	57
4	9.72 502	20	9.79 691	28	0.20 309	9.92 810	7	56
5	9.72 522	20	9.79 719	28	0.20 281	9.92 803	8	55
6	9.72 542	20	9.79 747	29	0.20 253	9.92 795	8	54
7	9.72 562	20	9.79 776	28	0.20 224	9.92 787	8	53
8	9.72 582	20	9.79 804	28	0.20 196	9.92 779	8	52
9	9.72 602	20	9.79 832	28	0.20 168	9.92 771	8	51
10	9.72 622	21	9.79 860	28	0.20 140	9.92 763	8	50
11	9.72 643	20	9.79 888	28	0.20 112	9.92 755	8	49
12	9.72 663	20	9.79 916	28	0.20 084	9.92 747	8	48
13	9.72 683	20	9.79 944	28	0.20 056	9.92 739	8	47
14	9.72 703	20	9.79 972	28	0.20 028	9.92 731	8	46
15	9.72 723	20	9.80 000	28	0.20 000	9.92 723	8	45
16	9.72 743	20	9.80 028	28	0.19 972	9.92 715	8	44
17	9.72 763	20	9.80 056	28	0.19 944	9.92 707	8	43
18	9.72 783	20	9.80 084	28	0.19 916	9.92 699	8	42
19	9.72 803	20	9.80 112	28	0.19 888	9.92 691	8	41
20	9.72 823	20	9.80 140	28	0.19 860	9.92 683	8	40
21	9.72 843	20	9.80 168	27	0.19 832	9.92 675	8	39
22	9.72 863	20	9.80 195	28	0.19 805	9.92 667	8	38
23	9.72 883	19	9.80 223	28	0.19 777	9.92 659	8	37
24	9.72 902	20	9.80 251	28	0.19 749	9.92 651	8	36
25	9.72 922	20	9.80 279	28	0.19 721	9.92 643	8	35
26	9.72 942	20	9.80 307	28	0.19 693	9.92 635	8	34
27	9.72 962	20	9.80 335	28	0.19 665	9.92 627	8	33
28	9.72 982	20	9.80 363	28	0.19 637	9.92 619	8	32
29	9.73 002	20	9.80 391	28	0.19 609	9.92 611	8	31
30	9.73 022	19	9.80 419	28	0.19 581	9.92 603	8	30
31	9.73 041	20	9.80 447	27	0.19 553	9.92 595	8	29
32	9.73 061	20	9.80 474	28	0.19 526	9.92 587	8	28
33	9.73 081	20	9.80 502	28	0.19 498	9.92 579	8	27
34	9.73 101	20	9.80 530	28	0.19 470	9.92 571	8	26
35	9.73 121	19	9.80 558	28	0.19 442	9.92 563	8	25
36	9.73 140	20	9.80 586	28	0.19 414	9.92 555	9	24
37	9.73 160	20	9.80 614	28	0.19 386	9.92 546	8	23
38	9.73 180	20	9.80 642	27	0.19 358	9.92 538	8	22
39	9.73 200	19	9.80 669	28	0.19 331	9.92 530	8	21
40	9.73 219	20	9.80 697	28	0.19 303	9.92 522	8	20
41	9.73 239	20	9.80 725	28	0.19 275	9.92 514	8	19
42	9.73 259	19	9.80 753	28	0.19 247	9.92 506	8	18
43	9.73 278	20	9.80 781	27	0.19 219	9.92 498	8	17
44	9.73 298	20	9.80 808	28	0.19 192	9.92 490	8	16
45	9.73 318	19	9.80 836	28	0.19 164	9.92 482	9	15
46	9.73 337	20	9.80 864	28	0.19 136	9.92 473	8	14
47	9.73 357	20	9.80 892	27	0.19 108	9.92 465	8	13
48	9.73 377	19	9.80 919	28	0.19 081	9.92 457	8	12
49	9.73 396	20	9.80 947	28	0.19 053	9.92 449	8	11
50	9.73 416	19	9.80 975	28	0.19 025	9.92 441	8	10
51	9.73 435	20	9.81 003	27	0.18 997	9.92 433	8	9
52	9.73 455	19	9.81 030	28	0.18 970	9.92 425	9	8
53	9.73 474	20	9.81 058	28	0.18 942	9.92 416	8	7
54	9.73 494	19	9.81 086	27	0.18 914	9.92 408	8	6
55	9.73 513	20	9.81 113	28	0.18 887	9.92 400	8	5
56	9.73 533	19	9.81 141	28	0.18 859	9.92 392	8	4
57	9.73 552	20	9.81 169	27	0.18 831	9.92 384	8	3
58	9.73 572	19	9.81 196	28	0.18 804	9.92 376	9	2
59	9.73 591	20	9.81 224	28	0.18 776	9.92 367	8	1
60	9.73 611		9.81 252		0.18 748	9.92 359		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	29	28	27
1	0,5	0,5	0,4
2	1,0	0,9	0,9
3	1,4	1,4	1,4
4	1,9	1,9	1,8
5	2,4	2,3	2,2
6	2,9	2,8	2,7
7	3,4	3,3	3,2
8	3,9	3,7	3,6
9	4,4	4,2	4,0
10	4,8	4,7	4,5
20	9,7	9,3	9,0
30	14,5	14,0	13,5
40	19,3	18,7	18,0
50	24,2	23,3	22,5

	21	20	19
1	0,4	0,3	0,3
2	0,7	0,7	0,6
3	1,0	1,0	1,0
4	1,4	1,3	1,3
5	1,8	1,7	1,6
6	2,1	2,0	1,9
7	2,4	2,3	2,2
8	2,8	2,7	2,5
9	3,2	3,0	2,8
10	3,5	3,3	3,2
20	7,0	6,7	6,3
30	10,5	10,0	9,5
40	14,0	13,3	12,7
50	17,5	16,7	15,8

	9	8	7
1	0,2	0,1	0,1
2	0,3	0,3	0,2
3	0,4	0,4	0,4
4	0,6	0,5	0,5
5	0,8	0,7	0,6
6	0,9	0,8	0,7
7	1,0	0,9	0,8
8	1,2	1,1	0,9
9	1,4	1,2	1,0
10	1,5	1,3	1,2
20	3,0	2,7	2,3
30	4,5	4,0	3,5
40	6,0	5,3	4,7
50	7,5	6,7	5,8

	$\frac{8}{29}$	$\frac{8}{28}$	$\frac{7}{28}$
0			
1	1,8	1,8	2,0
2	5,4	5,2	6,0
3	9,1	8,8	10,0
4	12,7	12,2	14,0
5	16,3	15,8	18,0
6	19,9	19,2	22,0
7	23,6	22,8	26,0
8	27,2	26,2	

P. P.

57°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

33°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.73 611	19	9.81 252	27	0.18 748	9.92 359	8	60
1	9.73 630	20	9.81 279	28	0.18 721	9.92 351	8	59
2	9.73 650	19	9.81 307	28	0.18 693	9.92 343	8	58
3	9.73 669	20	9.81 335	27	0.18 665	9.92 335	9	57
4	9.73 689	19	9.81 362	28	0.18 638	9.92 326	8	56
5	9.73 708	19	9.81 390	28	0.18 610	9.92 318	8	55
6	9.73 727	20	9.81 418	27	0.18 582	9.92 310	8	54
7	9.73 747	19	9.81 445	28	0.18 555	9.92 302	9	53
8	9.73 766	19	9.81 473	27	0.18 527	9.92 293	8	52
9	9.73 785	20	9.81 500	28	0.18 500	9.92 285	8	51
10	9.73 805	19	9.81 528	28	0.18 472	9.92 277	8	50
11	9.73 824	19	9.81 556	27	0.18 444	9.92 269	9	49
12	9.73 843	20	9.81 583	28	0.18 417	9.92 260	8	48
13	9.73 863	19	9.81 611	27	0.18 389	9.92 252	8	47
14	9.73 882	19	9.81 638	28	0.18 362	9.92 244	9	46
15	9.73 901	20	9.81 666	27	0.18 334	9.92 235	8	45
16	9.73 921	19	9.81 693	28	0.18 307	9.92 227	8	44
17	9.73 940	19	9.81 721	27	0.18 279	9.92 219	8	43
18	9.73 959	19	9.81 748	28	0.18 252	9.92 211	9	42
19	9.73 978	19	9.81 776	27	0.18 224	9.92 202	8	41
20	9.73 997	20	9.81 803	28	0.18 197	9.92 194	8	40
21	9.74 017	19	9.81 831	27	0.18 169	9.92 186	9	39
22	9.74 036	19	9.81 858	28	0.18 142	9.92 177	8	38
23	9.74 055	19	9.81 886	27	0.18 114	9.92 169	8	37
24	9.74 074	19	9.81 913	28	0.18 087	9.92 161	9	36
25	9.74 093	20	9.81 941	27	0.18 059	9.92 152	8	35
26	9.74 113	19	9.81 968	28	0.18 032	9.92 144	8	34
27	9.74 132	19	9.81 996	27	0.18 004	9.92 136	9	33
28	9.74 151	19	9.82 023	28	0.17 977	9.92 127	8	32
29	9.74 170	19	9.82 051	27	0.17 949	9.92 119	8	31
30	9.74 189	19	9.82 078	28	0.17 922	9.92 111	9	30
31	9.74 208	19	9.82 106	27	0.17 894	9.92 102	8	29
32	9.74 227	19	9.82 133	28	0.17 867	9.92 094	8	28
33	9.74 246	19	9.82 161	27	0.17 839	9.92 086	9	27
34	9.74 265	19	9.82 188	27	0.17 812	9.92 077	8	26
35	9.74 284	19	9.82 215	28	0.17 785	9.92 069	9	25
36	9.74 303	19	9.82 243	27	0.17 757	9.92 060	8	24
37	9.74 322	19	9 82 270	28	0.17 730	9.92 052	8	23
38	9.74 341	19	9.82 298	27	0.17 702	9.92 044	9	22
39	9.74 360	19	9.82 325	27	0.17 675	9.92 035	8	21
40	9.74 379	19	9.82 352	28	0.17 648	9.92 027	9	20
41	9.74 398	19	9.82 380	27	0.17 620	9.92 018	8	19
42	9.74 417	19	9.82 407	28	0.17 593	9.92 010	8	18
43	9.74 436	19	9.82 435	27	0.17 565	9.92 002	9	17
44	9.74 455	19	9.82 462	27	0.17 538	9.91 993	8	16
45	9.74 474	19	9.82 489	28	0.17 511	9.91 985	9	15
46	9.74 493	19	9.82 517	27	0.17 483	9.91 976	8	14
47	9.74 512	19	9.82 544	27	0.17 456	9.91 968	9	13
48	9.74 531	18	9.82 571	28	0.17 429	9.91 959	8	12
49	9.74 549	19	9.82 599	27	0.17 401	9.91 951	9	11
50	9.74 568	19	9.82 626	27	0.17 374	9.91 942	8	10
51	9.74 587	19	9.82 653	28	0.17 347	9.91 934	9	8
52	9.74 606	19	9.82 681	27	0.17 319	9.91 925	8	8
53	9.74 625	19	9.82 708	27	0.17 292	9.91 917	9	7
54	9.74 644	18	9.82 735	27	0.17 265	9.91 908	8	6
55	9.74 662	19	9.82 762	28	0.17 238	9.91 900	9	5
56	9.74 681	19	9.82 790	27	0.17 210	9.91 891	8	4
57	9.74 700	19	9.82 817	27	0.17 183	9.91 883	9	3
58	9.74 719	18	9.82 844	27	0.17 156	9.91 874	8	2
59	9.74 737	19	9.82 871	28	0.17 129	9.91 866	9	1
60	9.74 756		9.82 899		0.17 101	9.91 857		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	82	27
1	0,5	0,4
2	0,9	0,9
3	1,4	1,4
4	1,9	1,8
5	2,3	2,2
6	2,8	2,7
7	3,3	3,2
8	3,7	3,6
9	4,2	4,0
10	4,7	4,5
20	9,3	9,0
30	14,0	13,5
40	18,7	18,0
50	23,3	22,5

	20	19	18
1	0,3	0,3	0,3
2	0,7	0,6	0,6
3	1,0	1,0	0,9
4	1,3	1,3	1,2
5	1,7	1,6	1,5
6	2,0	1,9	1,8
7	2,3	2,2	2,1
8	2,7	2,5	2,4
9	3,0	2,8	2,7
10	3,3	3,2	3,0
20	6,7	6,3	6,0
30	10,0	9,5	9,0
40	13,3	12,7	12,0
50	16,7	15,8	15,0

	9	8
1	0,2	0,1
2	0,3	0,3
3	0,4	0,4
4	0,6	0,5
5	0,8	0,7
6	0,9	0,8
7	1,0	0,9
8	1,2	1,1
9	1,4	1,2
10	1,5	1,3
20	3,0	2,7
30	4,5	4,0
40	6,0	5,3
50	7,5	6,7

	$\frac{9}{28}$	$\frac{9}{27}$	$\frac{8}{27}$
0	1,6	1,5	1,7
1	4,7	4,5	5,1
2	7,8	7,5	8,4
3	10,9	10,5	11,8
4	14,0	13,5	15,2
5	17,1	16,5	18,6
6	20,2	19,5	21,9
7	23,3	22,5	25,3
8	26,4	25,5	
9			

P. P.

56°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

34°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.74 756	19	9.82 899	27	0.17 101	9.91 857	8	60
1	9.74 775	19	9.82 926	27	0.17 074	9.91 849	9	59
2	9.74 794	18	9.82 953	27	0.17 047	9.91 840	8	58
3	9.74 812	19	9.82 980	28	0.17 020	9.91 832	9	57
4	9.74 831	19	9.83 008	27	0.16 992	9.91 823	8	56
5	9.74 850	18	9.83 035	27	0.16 965	9.91 815	9	55
6	9.74 868	19	9.83 062	27	0.16 938	9.91 806	8	54
7	9.74 887	19	9.83 089	28	0.16 911	9.91 798	9	53
8	9.74 906	18	9.83 117	27	0.16 883	9.91 789	8	52
9	9.74 924	19	9.83 144	27	0.16 856	9.91 781	9	51
10	9.74 943	18	9.83 171	27	0.16 829	9.91 772	9	50
11	9.74 961	19	9.83 198	37	0.16 822	9.91 763	8	49
12	9.74 980	19	9.83 225	27	0.16 775	9.91 755	9	48
13	9.74 999	18	9.83 252	28	0.16 748	9.91 746	8	47
14	9.75 017	19	9.83 280	27	0.16 720	9.91 738	9	46
15	9.75 036	18	9.83 307	27	0.16 693	9.91 729	9	45
16	9.75 054	19	9.83 334	27	0.16 666	9.91 720	8	44
17	9.75 073	18	9.83 361	27	0.16 639	9.91 712	9	43
18	9.75 091	19	9.83 388	27	0.16 612	9.91 703	8	42
19	9.75 110	18	9.83 415	27	0.16 585	9.91 695	9	41
20	9.75 128	19	9.83 442	28	0.16 558	9.91 686	9	40
21	9.75 147	18	9.83 470	27	0.16 530	9.91 677	8	39
22	9.75 165	19	9.83 497	27	0.16 503	9.91 669	9	38
23	9.75 184	18	9.83 524	27	0.16 476	9.91 660	9	37
24	9.75 202	19	9.83 551	27	0.16 449	9.91 651	8	36
25	9.75 221	18	9.83 578	27	0.16 422	9.91 643	9	35
26	9.75 239	19	9.83 605	27	0.16 395	9.91 634	9	34
27	9.75 258	18	9.83 632	27	0.16 368	9.91 625	8	33
28	9.75 276	18	9.83 659	27	0.16 341	9.91 617	9	32
29	9.75 294	19	9.83 686	27	0.16 314	9.91 608	9	31
30	9.75 313	18	9.83 713	27	0.16 287	9.91 599	8	30
31	9.75 331	19	9.83 740	28	0.16 260	9.91 591	9	29
32	9.75 350	18	9.83 768	27	0.16 232	9.91 582	9	28
33	9.75 368	18	9.83 795	27	0.16 205	9.91 573	8	27
34	9.75 386	19	9.83 822	27	0.16 178	9.91 565	9	26
35	9.75 405	18	9.83 849	27	0.16 151	9.91 556	9	25
36	9.75 423	18	9.83 876	27	0.16 124	9.91 547	9	24
37	9.75 441	18	9.83 903	27	0.16 097	9.91 538	8	23
38	9.75 459	19	9.83 930	27	0.16 070	9.91 530	9	22
39	9.75 478	18	9.83 957	27	0.16 043	9.91 521	9	21
40	9.75 496	18	9.83 984	27	0.16 016	9.91 512	8	20
41	9.75 514	19	9.84 011	27	0.15 989	9.91 504	9	19
42	9.75 533	18	9.84 038	27	0.15 962	9.91 495	9	18
43	9.75 551	18	9.84 065	27	0.15 935	9.91 486	9	17
44	9.75 569	18	9.84 092	27	0.15 908	9.91 477	8	16
45	9.75 587	18	9.84 119	27	0.15 881	9.91 469	9	15
46	9.75 605	19	9.84 146	27	0.15 854	9.91 460	9	14
47	9.75 624	18	9.84 173	27	0.15 827	9.91 451	9	13
48	9.75 642	18	9.84 200	27	0.15 800	9.91 442	9	12
49	9.75 660	18	9.84 227	27	0.15 773	9.91 433	8	11
50	9.75 678	18	9.84 254	26	0.15 746	9.91 425	9	10
51	9.75 696	18	9.84 280	27	0.15 720	9.91 416	9	9
52	9.75 714	19	9.84 307	27	0.15 693	9.91 407	9	8
53	9.75 733	18	9.84 334	27	0.15 666	9.91 398	9	7
54	9.75 751	18	9.84 361	27	0.15 639	9.91 389	8	6
55	9.75 769	18	9.84 388	27	0.15 612	9.91 381	9	5
56	9.75 787	18	9.84 415	27	0.15 585	9.91 372	9	4
57	9.75 805	18	9.84 442	27	0.15 558	9.91 363	9	3
58	9.75 823	18	9.84 469	27	0.15 531	9.91 354	9	2
59	9.75 841	18	9.84 496	27	0.15 504	9.91 345	9	1
60	9.75 859		9.84 523		0.15 477	9.91 336		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	28	27	26
1	0,5	0,4	0,4
2	0,9	0,9	0,9
3	1,4	1,4	1,3
4	1,9	1,8	1,7
5	2,3	2,2	2,2
6	2,8	2,7	2,6
7	3,3	3,2	3,0
8	3,7	3,6	3,5
9	4,2	4,0	3,9
10	4,7	4,5	4,3
20	9,3	9,0	8,7
30	14,0	13,5	13,0
40	18,7	18,0	17,3
50	23,3	22,5	21,7

	19	18
1	0,3	0,3
2	0,6	0,6
3	1,0	0,9
4	1,3	1,2
5	1,6	1,5
6	1,9	1,8
7	2,2	2,1
8	2,5	2,4
9	2,8	2,7
10	3,2	3,0
20	6,3	6,0
30	9,5	9,0
40	12,7	12,0
50	15,8	15,0

	9	8
1	0,2	0,1
2	0,3	0,3
3	0,4	0,4
4	0,6	0,5
5	0,8	0,7
6	0,9	0,8
7	1,0	0,9
8	1,2	1,1
9	1,4	1,2
10	1,5	1,3
20	3,0	2,7
30	4,5	4,0
40	6,0	5,3
50	7,5	6,7

	9	8	8
	28	28	27
0	1,6	1,8	1,7
1	4,7	5,2	5,1
2	7,8	8,8	8,4
3	10,9	12,2	11,8
4	14,0	15,8	15,2
5	17,1	19,2	18,6
6	20,2	22,8	21,9
7	23,3	26,2	25,3
8	26,4		
9			

P. P.

55°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

35°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.75 859	18	9.84 523	27	0.15 477	9.91 336	8	60
1	9.75 877	18	9.84 550	26	0.15 450	9.91 328	9	59
2	9.75 895	18	9.84 576	27	0.15 424	9.91 319	9	58
3	9.75 913	18	9.84 603	27	0.15 397	9.91 310	9	57
4	9.75 931	18	9.84 630	27	0.15 370	9.91 301	9	56
5	9.75 949	18	9.84 657	27	0.15 343	9.91 292	9	55
6	9.75 967	18	9.84 684	27	0.15 316	9.91 283	9	54
7	9.75 985	18	9.84 711	27	0.15 289	9.91 274	8	53
8	9.76 003	18	9.84 738	26	0.15 262	9.91 266	9	52
9	9.76 021	18	9.84 764	27	0.15 236	9.91 257	9	51
10	9.76 039	18	9.84 791	27	0.15 209	9.91 248	9	50
11	9.76 057	18	9.84 818	27	0.15 182	9.91 239	9	49
12	9.76 075	18	9.84 845	27	0.15 155	9.91 230	9	48
13	9.76 093	18	9.84 872	27	0.15 128	9.91 221	9	47
14	9.76 111	18	9.84 899	26	0.15 101	9.91 212	9	46
15	9.76 129	17	9.84 925	27	0.15 075	9.91 203	9	45
16	9.76 146	18	9.84 952	27	0.15 048	9.91 194	9	44
17	9.76 164	18	9.84 979	27	0.15 021	9.91 185	9	43
18	9.76 182	18	9.85 006	27	0.14 994	9.91 176	9	42
19	9.76 200	18	9.85 033	26	0.14 967	9.91 167	9	41
20	9.76 218	18	9.85 059	27	0.14 941	9.91 158	9	40
21	9.76 236	17	9.85 086	27	0.14 914	9.91 149	8	39
22	9.76 253	18	9.85 113	27	0.14 887	9.91 141	9	38
23	9.76 271	18	9.85 140	26	0.14 860	9.91 132	9	37
24	9.76 289	18	9.85 166	27	0.14 834	9.91 123	9	36
25	9.76 307	17	9.85 193	27	0.14 807	9.91 114	9	35
26	9.76 324	18	9.85 220	27	0.14 780	9.91 105	9	34
27	9.76 342	18	9.85 247	26	0.14 753	9.91 096	9	33
28	9.76 360	18	9.85 273	27	0.14 727	9.91 087	9	32
29	9.76 378	17	9.85 300	27	0.14 700	9.91 078	9	31
30	9.76 395	18	9.85 327	27	0.14 673	9.91 069	9	30
31	9.76 413	18	9.85 354	26	0.14 646	9.91 060	9	29
32	9.76 431	17	9.85 380	27	0.14 620	9.91 051	9	28
33	9.76 448	18	9.85 407	27	0.14 593	9.91 042	9	27
34	9.76 466	18	9.85 434	26	0.14 566	9.91 033	10	26
35	9.76 484	17	9.85 460	27	0.14 540	9.91 023	9	25
36	9.76 501	18	9.85 487	27	0.14 513	9.91 014	9	24
37	9.76 519	18	9.85 514	26	0.14 486	9.91 005	9	23
38	9.76 537	17	9.85 540	27	0.14 460	9.90 996	9	22
39	9.76 554	18	9.85 567	27	0.14 433	9.90 987	9	21
40	9.76 572	18	9.85 594	26	0.14 406	9.90 978	9	20
41	9.76 590	17	9.85 620	27	0.14 380	9.90 969	9	19
42	9.76 607	18	9.85 647	27	0.14 353	9.90 960	9	18
43	9.76 625	17	9.85 674	26	0.14 326	9.90 951	9	17
44	9.76 642	18	9.85 700	27	0.14 300	9.90 942	9	16
45	9.76 660	17	9.85 727	27	0.14 273	9.90 933	9	15
46	9.76 677	18	9.85 754	26	0.14 246	9.90 924	9	14
47	9.76 695	17	9.85 780	27	0.14 220	9.90 915	9	13
48	9.76 712	18	9.85 807	27	0.14 193	9.90 906	10	12
49	9.76 730	17	9.85 834	26	0.14 166	9.90 896	9	11
50	9.76 747	18	9.85 860	27	0.14 140	9.90 887	9	10
51	9.76 765	17	9.85 887	26	0.14 113	9.90 878	9	9
52	9.76 782	18	9.85 913	27	0.14 087	9.90 869	9	8
53	9.76 800	17	9.85 940	27	0.14 060	9.90 860	9	7
54	9.76 817	18	9.85 967	26	0.14 033	9.90 851	9	6
55	9.76 835	17	9.85 993	27	0.14 007	9.90 842	10	5
56	9.76 852	18	9.86 020	26	0.13 980	9.90 832	9	4
57	9.76 870	17	9.86 046	27	0.13 954	9.90 823	9	3
58	9.76 887	17	9.86 073	27	0.13 927	9.90 814	9	2
59	9.76 904	18	9.86 100	26	0.13 900	9.90 805	9	1
60	9.76 922		9.86 126		0.13 874	9.90 796		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	27	26	18
1	0,4	0,4	0,3
2	0,9	0,9	0,6
3	1,4	1,3	0,9
4	1,8	1,7	1,2
5	2,2	2,2	1,5
6	2,7	2,6	1,8
7	3,2	3,0	2,1
8	3,6	3,5	2,4
9	4,0	3,9	2,7
10	4,5	4,3	3,0
20	9,0	8,7	6,0
30	13,5	13,0	9,0
40	18,0	17,3	12,0
50	22,5	21,7	15,0

	17	10	9	8
1	0,3	0,2	0,2	0,1
2	0,6	0,3	0,3	0,3
3	0,8	0,5	0,4	0,4
4	1,1	0,7	0,6	0,5
5	1,4	0,8	0,8	0,7
6	1,7	1,0	0,9	0,8
7	2,0	1,2	1,0	0,9
8	2,3	1,3	1,2	1,1
9	2,6	1,5	1,4	1,2
10	2,8	1,7	1,5	1,3
20	5,7	3,3	3,0	2,7
30	8,5	5,0	4,5	4,0
40	11,3	6,7	6,0	5,3
50	14,2	8,3	7,5	6,7

	$\frac{10}{27}$	$\frac{10}{26}$
0	1,4	1,3
1	4,1	3,9
2	6,8	6,5
3	9,4	9,1
4	12,2	11,7
5	14,8	14,3
6	17,6	16,9
7	20,2	19,5
8	22,9	22,1
9	25,6	24,7
10		

	$\frac{9}{27}$	$\frac{9}{26}$
0	1,5	1,4
1	4,5	4,3
2	7,5	7,2
3	10,5	10,1
4	13,5	13,0
5	16,5	15,9
6	19,5	18,8
7	22,5	21,7
8	25,5	24,6
9		

P. P.

54°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

36°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.76 922	17	9.86 126	27	0.13 874	9.90 796	9	60
1	9.76 939	18	9.86 153	26	0.13 847	9.90 787	10	59
2	9.76 957	17	9.86 179	27	0.13 821	9.90 777	9	58
3	9.76 974	17	9.86 206	26	0.13 794	9.90 768	9	57
4	9.76 991	18	9.86 232	27	0.13 768	9.90 759	9	56
5	9.77 009	17	9.86 259	26	0.13 741	9.90 750	9	55
6	9.77 026	17	9.86 285	27	0.13 715	9.90 741	10	54
7	9.77 043	18	9.86 312	26	0.13 688	9.90 731	9	53
8	9.77 061	17	9.86 338	27	0.13 662	9.90 722	9	52
9	9.77 078	17	9.86 365	27	0.13 635	9.90 713	9	51
10	9.77 095	17	9.86 392	26	0.13 608	9.90 704	10	50
11	9.77 112	18	9.86 418	27	0.13 582	9.90 694	9	49
12	9.77 130	17	9.86 445	26	0.13 555	9.90 685	9	48
13	9.77 147	17	9.86 471	27	0.13 529	9.90 676	9	47
14	9.77 164	17	9.86 498	26	0.13 502	9.90 667	10	46
15	9.77 181	18	9.86 524	27	0.13 476	9.90 657	9	45
16	9.77 199	17	9.86 551	26	0.13 449	9.90 648	9	44
17	9.77 216	17	9.86 577	26	0.13 423	9.90 639	9	43
18	9.77 233	17	9.86 603	27	0.13 397	9.90 630	10	42
19	9.77 250	18	9.86 630	26	0.13 370	9.90 620	9	41
20	9.77 268	17	9.86 656	27	0.13 344	9.90 611	9	40
21	9.77 285	17	9.86 683	26	0.13 317	9.90 602	10	39
22	9.77 302	17	9.86 709	27	0.13 291	9.90 592	9	38
23	9.77 319	17	9.86 736	26	0.13 264	9.90 583	9	37
24	9.77 336	17	9.86 762	27	0.13 238	9.90 574	9	36
25	9.77 353	17	9.86 789	26	0.13 211	9.90 565	10	35
26	9.77 370	17	9.86 815	27	0.13 185	9.90 555	9	34
27	9.77 387	18	9.86 842	26	0.13 158	9.90 546	9	33
28	9.77 405	17	9.86 868	26	0.13 132	9.90 537	10	32
29	9.77 422	17	9.86 894	27	0.13 106	9.90 527	9	31
30	9.77 439	17	9.86 921	26	0.13 079	9.90 518	9	30
31	9.77 456	17	9.86 947	27	0.13 053	9.90 509	10	29
32	9.77 473	17	9.86 974	26	0.13 026	9.90 499	9	28
33	9.77 490	17	9.87 000	27	0.13 000	9.90 490	10	27
34	9.77 507	17	9.87 027	26	0.12 973	9.90 480	9	26
35	9.77 524	17	9.87 053	26	0.12 947	9.90 471	9	25
36	9.77 541	17	9.87 079	27	0.12 921	9.90 462	10	24
37	9.77 558	17	9.87 106	26	0.12 894	9.90 452	9	23
38	9.77 575	17	9.87 132	26	0.12 868	9.90 443	9	22
39	9.77 592	17	9.87 158	27	0.12 842	9.90 434	10	21
40	9.77 609	17	9.87 185	26	0.12 815	9.90 424	9	20
41	9.77 626	17	9.87 211	27	0.12 789	9.90 415	10	19
42	9.77 643	17	9.87 238	26	0.12 762	9.90 405	9	18
43	9.77 660	17	9.87 264	26	0.12 736	9.90 396	10	17
44	9.77 677	17	9.87 290	27	0.12 710	9.90 386	9	16
45	9.77 694	17	9.87 317	26	0.12 683	9.90 377	9	15
46	9.77 711	17	9.87 343	26	0.12 657	9.90 368	10	14
47	9.77 728	16	9.87 369	27	0.12 631	9.90 358	9	13
48	9.77 744	17	9.87 396	26	0.12 604	9.90 349	10	12
49	9.77 761	17	9.87 422	26	0.12 578	9.90 339	9	11
50	9.77 778	17	9.87 448	27	0.12 552	9.90 330	10	10
51	9.77 795	17	9.87 475	26	0.12 525	9.90 320	9	9
52	9.77 812	17	9.87 501	26	0.12 499	9.90 311	10	8
53	9.77 829	17	9.87 527	27	0.12 473	9.90 301	9	7
54	9.77 846	16	9.87 554	26	0.12 446	9.90 292	10	6
55	9.77 862	17	9.87 580	26	0.12 420	9.90 282	9	5
56	9.77 879	17	9.87 606	27	0.12 394	9.90 273	10	4
57	9.77 896	17	9.87 633	26	0.12 367	9.90 263	9	3
58	9.77 913	17	9.87 659	26	0.12 341	9.90 254	10	2
59	9.77 930	16	9.87 685	26	0.12 315	9.90 244	9	1
60	9.77 946		9.87 711		0.12 289	9.90 235		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

53°

P. P.

	27	26
1	0,4	0,4
2	0,9	0,9
3	1,4	1,3
4	1,8	1,7
5	2,2	2,2
6	2,7	2,6
7	3,2	3,0
8	3,6	3,5
9	4,0	3,9
10	4,5	4,3
20	9,0	8,7
30	13,5	13,0
40	18,0	17,3
50	22,5	21,7

	18	17	16
1	0,3	0,3	0,3
2	0,6	0,6	0,5
3	0,9	0,8	0,8
4	1,2	1,1	1,1
5	1,5	1,4	1,3
6	1,8	1,7	1,6
7	2,1	2,0	1,9
8	2,4	2,3	2,1
9	2,7	2,6	2,4
10	3,0	2,8	2,7
20	6,0	5,7	5,3
30	9,0	8,5	8,0
40	12,0	11,3	10,7
50	15,0	14,2	13,3

	10	9
1	0,2	0,2
2	0,3	0,3
3	0,5	0,4
4	0,7	0,6
5	0,8	0,8
6	1,0	0,9
7	1,2	1,0
8	1,3	1,2
9	1,5	1,4
10	1,7	1,5
20	3,3	3,0
30	5,0	4,5
40	6,7	6,0
50	8,3	7,5

	$\frac{9}{27}$	$\frac{9}{26}$
0	1,5	1,4
1	4,5	4,3
2	7,5	7,2
3	10,5	10,1
4	13,5	13,0
5	16,5	15,9
6	19,5	18,8
7	22,5	21,7
8	25,5	24,6
9		

P. P.

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

37°

'	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	'
0	9.77 946	17	9.87 711	27	0.12 289	9.90 235	10	60
1	9.77 963	17	9.87 738	26	0.12 262	9.90 225	9	59
2	9.77 980	17	9.87 764	26	0.12 236	9.90 216	10	58
3	9.77 997	16	9.87 790	27	0.12 210	9.90 206	9	57
4	9.78 013	17	9.87 817	26	0.12 183	9.90 197	10	56
5	9.78 030	17	9.87 843	26	0.12 157	9.90 187	9	55
6	9.78 047	16	9.87 869	26	0.12 131	9.90 178	10	54
7	9.78 063	17	9.87 895	27	0.12 105	9.90 168	9	53
8	9.78 080	17	9.87 922	26	0.12 078	9.90 159	10	52
9	9.78 097	16	9.87 948	26	0.12 052	9.90 149	10	51
10	9.78 113	17	9.87 974	26	0.12 026	9.90 139	9	50
11	9.78 130	17	9.88 000	27	0.12 000	9.90 130	10	49
12	9.78 147	16	9.88 027	26	0.11 973	9.90 120	9	48
13	9.78 163	17	9.88 053	26	0.11 947	9.90 111	10	47
14	9.78 180	17	9.88 079	26	0.11 921	9.90 101	10	46
15	9.78 197	16	9.88 105	26	0.11 895	9.90 091	9	45
16	9.78 213	17	9.88 131	27	0.11 869	9.90 082	10	44
17	9.78 230	16	9.88 158	26	0.11 842	9.90 072	9	43
18	9.78 246	17	9.88 184	26	0.11 816	9.90 063	10	42
19	9.78 263	17	9.88 210	26	0.11 790	9.90 053	10	41
20	9.78 280	16	9.88 236	26	0.11 764	9.90 043	9	40
21	9.78 296	17	9.88 262	27	0.11 738	9.90 034	10	39
22	9.78 313	16	9.88 289	26	0.11 711	9.90 024	10	38
23	9.78 329	17	9.88 315	26	0.11 685	9.90 014	9	37
24	9.78 346	16	9.88 341	26	0.11 659	9.90 005	10	36
25	9.78 362	17	9.88 367	26	0.11 633	9.89 995	10	35
26	9.78 379	16	9.88 393	27	0.11 607	9.89 985	9	34
27	9.78 395	17	9.88 420	26	0.11 580	9.89 976	10	33
28	9.78 412	16	9.88 446	26	0.11 554	9.89 966	10	32
29	9.78 428	17	9.88 472	26	0.11 528	9.89 956	9	31
30	9.78 445	16	9.88 498	26	0.11 502	9.89 947	10	30
31	9.78 461	17	9.88 524	26	0.11 476	9.89 937	10	29
32	9.78 478	16	9.88 550	27	0.11 450	9.89 927	9	28
33	9.78 494	16	9.88 577	26	0.11 423	9.89 918	10	27
34	9.78 510	17	9.88 603	26	0.11 397	9.89 908	10	26
35	9.78 527	16	9 88 629	26	0.11 371	9.89 898	10	25
36	9.78 543	17	9.88 655	26	0.11 345	9.89 888	9	24
37	9.78 560	16	9.88 681	26	0.11 319	9.89 879	10	23
38	9.78 576	16	9.88 707	26	0.11 293	9.89 869	10	22
39	9.78 592	17	9.88 733	26	0.11 267	9.89 859	10	21
40	9.78 609	16	9.88 759	27	0.11 241	9.89 849	9	20
41	9.78 625	17	9.88 786	26	0.11 214	9.89 840	10	19
42	9.78 642	16	9.88 812	26	0.11 188	9.89 830	10	18
43	9.78 658	16	9.88 838	26	0.11 162	9.89 820	10	17
44	9.78 674	17	9.88 864	26	0.11 136	9.89 810	9	16
45	9.78 691	16	9.88 890	26	0.11 110	9.89 801	10	15
46	9.78 707	16	9.88 916	26	0.11 084	9.89 791	10	14
47	9.78 723	16	9.88 942	26	0.11 058	9.89 781	10	13
48	9.78 739	17	9.88 968	26	0.11 032	9.89 771	10	12
49	9.78 756	16	9.88 994	26	0.11 006	9.89 761	9	11
50	9.78 772	16	9.89 020	26	0.10 980	9.89 752	10	10
51	9.78 788	17	9.89 046	27	0.10 954	9.89 742	10	9
52	9.78 805	16	9.89 073	26	0.10 927	9.89 732	10	8
53	9.78 821	16	9.89 099	26	0.10 901	9.89 722	10	7
54	9.78 837	16	9.89 125	26	0.10 875	9.89 712	10	6
55	9.78 853	16	9.89 151	26	0.10 849	9.89 702	9	5
56	9.78 869	17	9.89 177	26	0.10 823	9.89 693	10	4
57	9.78 886	16	9.89 203	26	0.10 797	9.89 683	10	3
58	9.78 902	16	9.89 229	26	0.10 771	9.89 673	10	2
59	9.78 918	16	9.89 255	26	0.10 745	9.89 663	10	1
60	9.78 934		9.89 281		0.10 719	9.89 653		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	'

P. P.

	27	26
1	0,4	0,4
2	0,9	0,9
3	1,4	1,3
4	1,8	1,7
5	2,2	2,2
6	2,7	2,6
7	3,2	3,0
8	3,6	3,5
9	4,0	3,9
10	4,5	4,3
20	9,0	8,7
30	13,5	13,0
40	18,0	17,3
50	22,5	21,7

	17	16
1	0,3	0,3
2	0,6	0,5
3	0,8	0,8
4	1,1	1,1
5	1,4	1,3
6	1,7	1,6
7	2,0	1,9
8	2,3	2,1
9	2,6	2,4
10	2,8	2,7
20	5,7	5,3
30	8,5	8,0
40	11,3	10,7
50	14,2	13,3

	10	9
1	0,2	0,2
2	0,3	0,3
3	0,5	0,4
4	0,7	0,6
5	0,8	0,8
6	1,0	0,9
7	1,2	1,0
8	1,3	1,2
9	1,5	1,4
10	1,7	1,5
20	3,3	3,0
30	5,0	4,5
40	6,7	6,0
50	8,3	7,5

	$\frac{10}{27}$	$\frac{10}{26}$
0	1,4	1,3
1	4,1	3,9
2	6,8	6,5
4	9,4	9,1
5	12,2	11,7
6	14,8	14,3
7	17,6	16,9
8	20,2	19,5
9	22,9	22,1
10	25,6	24,7

P. P.

52°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

38°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.78 934	16	9.89 281	26	0.10 719	9.89 653	10	60
1	9.78 950	17	9.89 307	26	0.10 693	9.89 643	10	59
2	9.78 967	16	9.89 333	26	0.10 667	9.89 633	9	58
3	9.78 983	16	9.89 359	26	0.10 641	9.89 624	10	57
4	9.78 999	16	9.89 385	26	0.10 615	9.89 614	10	56
5	9.79 015	16	9.89 411	26	0.10 589	9.89 604	10	55
6	9.79 031	16	9.89 437	26	0.10 563	9.89 594	10	54
7	9.79 047	16	9.89 463	26	0.10 537	9.89 584	10	53
8	9.79 063	16	9.89 489	26	0.10 511	9.89 574	10	52
9	9.79 079	16	9.89 515	26	0.10 485	9.89 564	10	51
10	9.79 095	16	9.89 541	26	0.10 459	9.89 554	10	50
11	9.79 111	17	9.89 567	26	0.10 433	9.89 544	10	49
12	9.79 128	16	9.89 593	26	0.10 407	9.89 534	10	48
13	9.79 144	16	9.89 619	26	0.10 381	9.89 524	10	47
14	9.79 160	16	9.89 645	26	0.10 355	9.89 514	10	46
15	9.79 176	16	9.89 671	26	0.10 329	9.89 504	9	45
16	9.79 192	16	9.89 697	26	0.10 303	9.89 495	10	44
17	9.79 208	16	9.89 723	26	0.10 277	9.89 485	10	43
18	9.79 224	16	9.89 749	26	0.10 251	9.89 475	10	42
19	9.79 240	16	9.89 775	26	0.10 225	9.89 465	10	41
20	9.79 256	16	9.89 801	26	0.10 199	9.89 455	10	40
21	9.79 272	16	9.89 827	26	0.10 173	9.89 445	10	39
22	9.79 288	16	9.89 853	26	0.10 147	9.89 435	10	38
23	9.79 304	15	9.89 879	26	0.10 121	9.89 425	10	37
24	9.79 319	16	9.89 905	26	0.10 095	9.89 415	10	36
25	9.79 335	16	9.89 931	26	0.10 069	9.89 405	10	35
26	9.79 351	16	9.89 957	26	0.10 043	9.89 395	10	34
27	9.79 367	16	9.89 983	26	0.10 017	9.89 385	10	33
28	9.79 383	16	9.90 009	26	0.09 991	9.89 375	11	32
29	9.79 399	16	9.90 035	26	0.09 965	9.89 364	10	31
30	9.79 415	16	9.90 061	25	0.09 939	9.89 354	10	30
31	9.79 431	16	9.90 086	26	0.09 914	9.89 344	10	29
32	9.79 447	16	9.90 112	26	0.09 888	9.89 334	10	28
33	9.79 463	15	9.90 138	26	0.09 862	9.89 324	10	27
34	9.79 478	16	9.90 164	26	0.09 836	9.89 314	10	26
35	9.79 494	16	9.90 190	26	0.09 810	9.89 304	10	25
36	9.79 510	16	9.90 216	26	0.09 784	9.89 294	10	24
37	9.79 526	16	9.90 242	26	0.09 758	9.89 284	10	23
38	9.79 542	16	9.90 268	26	0.09 732	9.89 274	10	22
39	9.79 558	15	9.90 294	26	0.09 706	9.89 264	10	21
40	9.79 573	16	9.90 320	26	0.09 680	9.89 254	10	20
41	9.79 589	16	9.90 346	25	0.09 654	9.89 244	11	19
42	9.79 605	16	9.90 371	26	0.09 629	9.89 233	10	18
43	9.79 621	15	9.90 397	26	0.09 603	9.89 223	10	17
44	9.79 636	16	9.90 423	26	0.09 577	9.89 213	10	16
45	9.79 652	16	9.90 449	26	0.09 551	9.89 203	10	15
46	9.79 668	16	9.90 475	26	0.09 525	9.89 193	10	14
47	9.79 684	15	9.90 501	26	0.09 499	9.89 183	10	13
48	9.79 699	16	9.90 527	26	0.09 473	9.89 173	11	12
49	9.79 715	16	9.90 553	25	0.09 447	9.89 162	10	11
50	9.79 731	15	9.90 578	26	0.09 422	9.89 152	10	10
51	9.79 746	16	9.90 604	26	0.09 396	9.89 142	10	9
52	9.79 762	16	9.90 630	26	0.09 370	9.89 132	10	8
53	9.79 778	15	9.90 656	26	0.09 344	9.89 122	10	7
54	9.79 793	16	9.90 682	26	0.09 318	9.89 112	11	6
55	9.79 809	16	9.90 708	26	0.09 292	9.89 101	10	5
56	9.79 825	15	9.90 734	25	0.09 266	9.89 091	10	4
57	9.79 840	16	9.90 759	26	0.09 241	9.89 081	10	3
58	9.79 856	16	9.90 785	26	0.09 215	9.89 071	11	2
59	9.79 872	15	9.90 811	26	0.09 189	9.89 060	10	1
60	9.79 887		9.90 837		0.09 163	9.89 050		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	26	25
1	0,4	0,4
2	0,9	0,8
3	1,3	1,2
4	1,7	1,7
5	2,2	2,1
6	2,6	2,5
7	3,0	2,9
8	3,5	3,3
9	3,9	3,8
10	4,3	4,2
20	8,7	8,3
30	13,0	12,5
40	17,3	16,7
50	21,7	20,8

	17	16	15
1	0,3	0,3	0,2
2	0,6	0,5	0,5
3	0,8	0,8	0,8
4	1,1	1,1	1,0
5	1,4	1,3	1,2
5	1,7	1,6	1,5
7	2,0	1,9	1,8
8	2,3	2,1	2,0
9	2,6	2,4	2,2
10	2,8	2,7	2,5
20	5,7	5,3	5,0
30	8,5	8,0	7,5
40	11,3	10,7	10,0
50	14,2	13,3	12,5

	11	10	9
1	0,2	0,2	0,2
2	0,4	0,3	0,3
3	0,6	0,5	0,4
4	0,7	0,7	0,6
5	0,9	0,8	0.8
6	1,1	1,0	0,9
7	1,3	1,2	1,0
8	1,5	1,3	1,2
9	1,6	1,5	1,4
10	1,8	1,7	1,5
20	3,7	3,3	3,0
30	5,5	5,0	4,5
40	7,3	6,7	6,0
50	9,2	8,3	7,5

	10 26	10 25	9 26
0	1,3	1,2	1,4
1	3,9	3,8	4,3
2	6,5	6,2	7,2
3	9,1	8,8	10,1
4	11,7	11,2	13,0
5	14,3	13,8	15,9
6	16,9	16,2	18,8
7	19,5	18,8	21,7
8	22,1	21,2	24,6
9	24,7	23,8	—
10			

P. P.

51°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

39°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.79 887	16	9.90 837	26	0.09 163	9.89 050	10	**60**
1	9.79 903	15	9.90 863	26	0.09 137	9.89 040	10	59
2	9.79 918	16	9.90 889	25	0.09 111	9.89 030	10	58
3	9.79 934	16	9.90 914	26	0.09 086	9.89 020	11	57
4	9.79 950	15	9.90 940	26	0.09 060	9.89 009	10	56
5	9.79 965	16	9.90 966	26	0.09 034	9.88 999	10	55
6	9.79 981	15	9.90 992	26	0.09 008	9.88 989	11	54
7	9.79 996	16	9.91 018	25	0.08 982	9.88 978	10	53
8	9.80 012	15	9.91 043	26	0.08 957	9.88 968	10	52
9	9.80 027	16	9.91 069	26	0.08 931	9.88 958	10	51
10	9.80 043	15	9.91 095	26	0.08 905	9.88 948	11	**50**
11	9.80 058	16	9.91 121	26	0.08 879	9.88 937	10	49
12	9.80 074	15	9.91 147	25	0.08 853	9.88 927	10	48
13	9.80 089	16	9.91 172	26	0.08 828	9.88 917	11	47
14	9.80 105	15	9.91 198	26	0.08 802	9.88 906	10	46
15	9.80 120	16	9.91 224	26	0.08 776	9.88 896	10	45
16	9.80 136	15	9.91 250	26	0.08 750	9.88 886	11	44
17	9.80 151	15	9.91 276	25	0.08 724	9.88 875	10	43
18	9.80 166	16	9.91 301	26	0.08 699	9.88 865	10	42
19	9.80 182	15	9.91 327	26	0.08 673	9.88 855	11	41
20	9.80 197	16	9.91 353	26	0.08 647	9.88 844	10	**40**
21	9.80 213	15	9.91 379	25	0.08 621	9.88 834	10	39
22	9.80 228	16	9.91 404	26	0.08 596	9.88 824	11	38
23	9.80 244	15	9.91 430	26	0.08 570	9.88 813	10	37
24	9.80 259	15	9.91 456	26	0.08 544	9.88 803	10	36
25	9.80 274	16	9.91 482	25	0.08 518	9.88 793	11	35
26	9.80 290	15	9.91 507	26	0.08 493	9.88 782	10	34
27	9.80 305	15	9.91 533	26	0.08 467	9.88 772	11	33
28	9.80 320	16	9.91 559	26	0.08 441	9.88 761	10	32
29	9.80 336	15	9.91 585	25	0.08 415	9.88 751	10	31
30	9.80 351	15	9.91 610	26	0.08 390	9.88 741	11	**30**
31	9.80 366	16	9.91 636	26	0.08 364	9.88 730	10	29
32	9.80 382	15	9.91 662	26	0.08 338	9.88 720	11	28
33	9.80 397	15	9.91 688	25	0.08 312	9.88 709	10	27
34	9.80 412	16	9.91 713	26	0.08 287	9.88 699	11	26
35	9.80 428	15	9.91 739	26	0.08 261	9.88 688	10	25
36	9.80 443	15	9.91 765	26	0.08 235	9.88 678	10	24
37	9.80 458	15	9.91 791	25	0.08 209	9.88 668	11	23
38	9.80 473	16	9.91 816	26	0.08 184	9.88 657	10	22
39	9.80 489	15	9.91 842	26	0.08 158	9.88 647	11	21
40	9.80 504	15	9.91 868	25	0.08 132	9.88 636	10	**20**
41	9.80 519	15	9.91 893	26	0.08 107	9.88 626	11	19
42	9.80 534	16	9.91 919	26	0.08 081	9.88 615	10	18
43	9.80 550	15	9.91 945	26	0.08 055	9.88 605	11	17
44	9.80 565	15	9.91 971	25	0.08 029	9.88 594	10	16
45	9.80 580	15	9.91 996	26	0.08 004	9.88 584	11	15
46	9.80 595	15	9.92 022	26	0.07 978	9.88 573	10	14
47	9.80 610	15	9.92 048	25	0.07 952	9.88 563	11	13
48	9.80 625	16	9.92 073	26	0.07 927	9.88 552	10	12
49	9.80 641	15	9.92 099	26	0.07 901	9.88 542	11	11
50	9.80 656	15	9.92 125	25	0.07 875	9.88 531	10	**10**
51	9.80 671	15	9.92 150	26	0.07 850	9.88 521	11	9
52	9.80 686	15	9.92 176	26	0.07 824	9.88 510	11	8
53	9.80 701	15	9.92 202	25	0.07 798	9.88 499	10	7
54	9.80 716	15	9.92 227	26	0.07 773	9.88 489	11	6
55	9.80 731	15	9.92 253	26	0.07 747	9.88 478	10	5
56	9.80 746	16	9.92 279	25	0.07 721	9.88 468	11	4
57	9.80 762	15	9.92 304	26	0.07 696	9.88 457	10	3
58	9.80 777	15	9.92 330	26	0.07 670	9.88 447	11	2
59	9.80 792	15	9.92 356	25	0.07 644	9.88 436	11	1
60	9.80 807		9.92 381		0.07 619	9.88 425		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	26	**25**
1	0,4	0,4
2	0,9	0,8
3	1,3	1,2
4	1,7	1,7
5	2,2	2,1
6	2,6	2,5
7	3,0	2,9
8	3,5	3,3
9	3,9	3,8
10	4,3	4,2
20	8,7	8,3
30	13,0	12,5
40	17,3	16,7
50	21,7	20,8

	16	**15**
1	0,3	0,2
2	0,5	0,5
3	0,8	0,8
4	1,1	1,0
5	1,3	1,2
6	1,6	1,5
7	1,9	1,8
8	2,1	2,0
9	2,4	2,2
10	2,7	2,5
20	5,3	5,0
30	8,0	7,5
40	10,7	10,0
50	13,3	12,5

	11	**10**
1	0,2	0,2
2	0,4	0,3
3	0,6	0,5
4	0,7	0,7
5	0,9	0,8
6	1,1	1,0
7	1,3	1,2
8	1,5	1,3
9	1,6	1,5
10	1,8	1,7
20	3,7	3,3
30	5,5	5,0
40	7,3	6,7
50	9,2	8,3

	11 **26**	**11** **25**
0	1,2	1,1
1	3,5	3,4
2	5,9	5,7
3	8,3	7,9
4	10,6	10,2
5	13,0	12,5
6	15,4	14,8
7	17,7	17,1
8	20,1	19,3
9	22,5	21,6
10	24,8	23,9
11		

P. P.

50°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

40°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.80 807		9.92 381		0.07 619	9.88 425		60
1	9.80 822	15	9.92 407	26	0.07 593	9.88 415	10	59
2	9.80 837	15	9.92 433	26	0.07 567	9.88 404	11	58
3	9.80 852	15	9.92 458	25	0.07 542	9.88 394	10	57
4	9.80 867	15	9.92 484	26	0.07 516	9.88 383	11	56
5	9.80 882	15	9.92 510	26	0.07 490	9.88 372	11	55
6	9.80 897	15	9.92 535	25	0.07 465	9.88 362	10	54
7	9.80 912	15	9.92 561	26	0.07 439	9.88 351	11	53
8	9.80 927	15	9.92 587	26	0.07 413	9.88 340	11	52
9	9.80 942	15	9.92 612	25	0.07 388	9.88 330	10	51
10	9.80 957	15	9.92 638	26	0.07 362	9.88 319	11	50
11	9.80 972	15	9.92 663	25	0.07 337	9.88 308	11	49
12	9.80 987	15	9.92 689	26	0.07 311	9.88 298	10	48
13	9.81 002	15	9.92 715	26	0.07 285	9.88 287	11	47
14	9.81 017	15	9.92 740	25	0.07 260	9.88 276	11	46
15	9.81 032	15	9.92 766	26	0.07 234	9.88 266	10	45
16	9.81 047	15	9.92 792	26	0.07 208	9.88 255	11	44
17	9.81 061	14	9.92 817	25	0.07 183	9.88 244	11	43
18	9.81 076	15	9.92 843	26	0.07 157	9.88 234	10	42
19	9.81 091	15	9.92 868	25	0.07 132	9.88 223	11	41
20	9.81 106	15	9.92 894	26	0.07 106	9.88 212	11	40
21	9.81 121	15	9.92 920	26	0.07 080	9.88 201	11	39
22	9.81 136	15	9.92 945	25	0.07 055	9.88 191	10	38
23	9.81 151	15	9.92 971	26	0.07 029	9.88 180	11	37
24	9.81 166	15	9.92 996	25	0.07 004	9.88 169	11	36
25	9.81 180	14	9.93 022	26	0.06 978	9.88 158	11	35
26	9.81 195	15	9.93 048	26	0.06 952	9.88 148	10	34
27	9.81 210	15	9.93 073	25	0.06 927	9.88 137	11	33
28	9.81 225	15	9.93 099	26	0.06 901	9.88 126	11	32
29	9.81 240	15	9.93 124	25	0.06 876	9.88 115	11	31
30	9.81 254	14	9.93 150	26	0.06 850	9.88 105	10	30
31	9.81 269	15	9.93 175	25	0.06 825	9.88 094	11	29
32	9.81 284	15	9.93 201	26	0.06 799	9.88 083	11	28
33	9.81 299	15	9.93 227	26	0.06 773	9.88 072	11	27
34	9.81 314	15	9.93 252	25	0.06 748	9.88 061	11	26
35	9.81 328	14	9.93 278	26	0.06 722	9.88 051	10	25
36	9.81 343	15	9.93 303	25	0.06 697	9.88 040	11	24
37	9.81 358	15	9.93 329	26	0.06 671	9.88 029	11	23
38	9.81 372	14	9.93 354	25	0.06 646	9.88 018	11	22
39	9.81 387	15	9.93 380	26	0.06 620	9.88 007	11	21
40	9.81 402	15	9.93 406	26	0.06 594	9.87 996	11	20
41	9.81 417	15	9.93 431	25	0.06 569	9.87 985	11	19
42	9.81 431	14	9.93 457	26	0.06 543	9.87 975	10	18
43	9.81 446	15	9.93 482	25	0.06 518	9.87 964	11	17
44	9.81 461	15	9.93 508	26	0.06 492	9.87 953	11	16
45	9.81 475	14	9.93 533	25	0.06 467	9.87 942	11	15
46	9.81 490	15	9.93 559	26	0.06 441	9.87 931	11	14
57	9.81 505	15	9.93 584	25	0.06 416	9.87 920	11	13
48	9.81 519	14	9.93 610	26	0.06 390	9.87 909	11	12
49	9.81 534	15	9.93 636	26	0.06 364	9.87 898	11	11
50	9.81 549	15	9.93 661	25	0.06 339	9.87 887	11	10
51	9.81 563	14	9.93 687	26	0.06 313	9.87 877	10	9
52	9.81 578	15	9.93 712	25	0.06 288	9.87 866	11	8
53	9.81 592	14	9.93 738	26	0.06 262	9.87 855	11	7
54	9.81 607	15	9.93 763	25	0.06 237	9.87 844	11	6
55	9.81 622	15	9.93 789	26	0.06 211	9.87 833	11	5
56	9.81 636	14	9.93 814	25	0.06 186	9.87 822	11	4
57	9.81 651	15	9.93 840	26	0.06 160	9.87 811	11	3
58	9.81 665	14	9.93 865	25	0.06 135	9.87 800	11	2
59	9.81 680	15	9.93 891	26	0.06 109	9.87 789	11	1
60	9.81 694	14	9.93 916	25	0.06 084	9.87 778	11	0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	26	25
1	0,4	0,4
2	0,9	0,8
3	1,3	1,2
4	1,7	1,7
5	2,2	2,1
6	2,6	2,5
7	3,0	2,9
8	3,5	3,3
9	3,9	3,8
10	4,3	4,2
20	8,7	8,3
30	13,0	12,5
40	17,3	16,7
50	21,7	20,8

	15	14
1	0,2	0,2
2	0,5	0,5
3	0,8	0,7
4	1,0	0,9
5	1,2	1,2
6	1,5	1,4
7	1,8	1,6
8	2,0	1,9
9	2,2	2,1
10	2,5	2,3
20	5,0	4,7
30	7,5	7,0
40	10,0	9,3
50	12,5	11,7

	11	10
1	0,2	0,2
2	0,4	0,3
3	0,6	0,5
4	0,7	0,7
5	0,9	0,8
6	1,1	1,0
7	1,3	1,2
8	1,5	1,3
9	1,6	1,5
10	1,8	1,7
20	3,7	3,3
30	5,5	5,0
40	7,3	6,7
50	9,2	8,3

	$\frac{11}{26}$	$\frac{10}{26}$	$\frac{10}{25}$
0	1,2	1,3	1,2
1	3,5	3,9	3,8
2	5,9	6,5	6,2
3	8,3	9,1	8,8
4	10,6	11,7	11,2
5	13,0	14,3	13,8
6	15,4	16,9	16,2
7	17,7	19,5	18,8
8	20,1	22,1	21,2
9	22,5	24,7	23,8
10	24,8		
11			

P. P.

49°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

41°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.81 694		9.93 916		0.06 084	9.87 778		**60**
1	9.81 709	15	9.93 942	26	0.06 058	9.87 767	11	59
2	9.81 723	14	9.93 967	25	0.06 033	9.87 756	11	58
3	9.81 738	15	9.93 993	26	0.06 007	9.87 745	11	57
4	9.81 752	14	9.94 018	25	0.05 982	9.87 734	11	56
5	9.81 767	15	9.94 044	26	0.05 956	9.87 723	11	55
6	9.81 781	14	9.94 069	25	0.05 931	9.87 712	11	54
7	9.81 796	15	9.94 095	26	0.05 905	9.87 701	11	53
8	9.81 810	14	9.94 120	25	0.05 880	9.87 690	11	52
9	9.81 825	15	9.94 146	26	0.05 854	9.87 679	11	51
10	9.81 839	14	9.94 171	25	0.05 829	9.87 668	11	**50**
11	9.81 854	15	9.94 197	26	0.05 803	9.87 657	11	49
12	9.81 868	14	9.94 222	25	0.05 778	9.87 646	11	48
13	9.81 882	14	9.94 248	26	0.05 752	9.87 635	11	47
14	9.81 897	15	9.94 273	25	0.05 727	9.87 624	11	46
15	9.81 911	14	9.94 299	26	0.05 701	9.87 613	11	45
16	9.81 926	15	9.94 324	25	0.05 676	9.87 601	12	44
17	9.81 940	14	9.94 350	26	0.05 650	9.87 590	11	43
18	9.81 955	15	9.94 375	25	0.05 625	9.87 579	11	42
19	9.81 969	14	9.94 401	26	0.05 599	9.87 568	11	41
20	9.81 983	14	9.94 426	25	0.05 574	9.87 557	11	**40**
21	9.81 998	15	9.94 452	26	0.05 548	9.87 546	11	39
22	9.82 012	14	9.94 477	25	0.05 523	9.87 535	11	38
23	9.82 026	14	9.94 503	26	0.05 497	9.87 524	11	37
24	9.82 041	15	9.94 528	25	0.05 472	9.87 513	11	36
25	9.82 055	14	9.94 554	26	0.05 446	9.87 501	12	35
26	9.82 069	14	9.94 579	25	0.05 421	9.87 490	11	34
27	9.82 084	15	9.94 604	25	0.05 396	9.87 479	11	33
28	9.82 098	14	9.94 630	26	0.05 370	9.87 468	11	32
29	9.82 112	14	9.94 655	25	0.05 345	9.87 457	11	31
30	9.82 126	14	9.94 681	26	0.05 319	9.87 446	11	**30**
31	9.82 141	15	9.94 706	25	0.05 294	9.87 434	12	29
32	9.82 155	14	9.94 732	26	0.05 268	9.87 423	11	28
33	9.82 169	14	9.94 757	25	0.05 243	9.87 412	11	27
34	9.82 184	15	9.94 783	26	0.05 217	9.87 401	11	26
35	9.82 198	14	9.94 808	25	0.05 192	9.87 390	11	25
36	9.82 212	14	9.94 834	26	0.05 166	9.87 378	12	24
37	9.82 226	14	9.94 859	25	0.05 141	9.87 367	11	23
38	9.82 240	14	9.94 884	25	0.05 116	9.87 356	11	22
39	9.82 255	15	9.94 910	26	0.05 090	9.87 345	11	21
40	9.82 269	14	9.94 935	25	0.05 065	9.87 334	11	**20**
41	9.82 283	14	9.94 961	26	0.05 039	9.87 322	12	19
42	9.82 297	14	9.94 986	25	0.05 014	9.87 311	11	18
43	9.82 311	14	9.95 012	26	0.04 988	9.87 300	11	17
44	9.82 326	15	9.95 037	25	0.04 963	9.87 288	12	16
45	9.82 340	14	9.95 062	25	0.04 938	9.87 277	11	15
46	9.82 354	14	9.95 088	26	0.04 912	9.87 266	11	14
47	9.82 368	14	9.95 113	25	0.04 887	9.87 255	11	13
48	9.82 382	14	9.95 139	26	0.04 861	9.87 243	12	12
49	9.82 396	14	9.95 164	25	0.04 836	9.87 232	11	11
50	9.82 410	14	9.95 190	26	0.04 810	9.87 221	11	**10**
51	9.82 424	14	9.95 215	25	0.04 785	9.87 209	12	9
52	9.82 439	15	9.95 240	25	0.04 760	9.87 198	11	8
53	9.82 453	14	9.95 266	26	0.04 734	9.87 187	11	7
54	9.82 467	14	9.95 291	25	0.04 709	9.87 175	12	6
55	9.82 481	14	9.95 317	26	0.04 683	9.87 164	11	5
56	9.82 495	14	9.95 342	25	0.04 658	9.87 153	11	4
57	9.82 509	14	9.95 368	26	0.04 632	9.87 141	12	3
58	9.82 523	14	9.95 393	25	0.04 607	9.87 130	11	2
59	9.82 537	14	9.95 418	25	0.04 582	9.87 119	11	1
60	9.82 551	14	9.95 444	26	0.04 556	9.87 107	12	**0**
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	26	**25**
1	0,4	0,4
2	0,9	0,8
3	1,3	1,2
4	1,7	1,7
5	2,2	2,1
6	2,6	2,5
7	3,0	2,9
8	3,5	3,3
9	3,9	3,8
10	4,3	4,2
20	8,7	8,3
30	13,0	12,5
40	17,3	16,7
50	21,7	20,8

	15	**14**
1	0,2	0,2
2	0,5	0,5
3	0,8	0,7
4	1,0	0,9
5	1,2	1,2
6	1,5	1,4
7	1,8	1,6
8	2,0	1,9
9	2,2	2,1
10	2,5	2,3
20	5,0	4,7
30	7,5	7,0
40	10,0	9,3
50	12,5	11,7

	12	**11**
1	0,2	0,2
2	0,4	0,4
3	0,6	0,6
4	0,8	0,7
5	1,0	0,9
6	1,2	1,1
7	1,4	1,3
8	1,6	1 5
9	1,8	1,6
10	2,0	1,8
20	4,0	3,7
30	6,0	5,5
40	8,0	7,3
50	10,0	9,2

	12 — **26**	**12** — **25**	**11** — **25**
0	1,1	1,1	1,1
1	3,2	3,1	3,4
2	5,4	5,2	5,7
3	7,6	7,3	7,9
4	9,8	9,4	10,2
5	11,9	11,5	12,5
6	14,1	13,5	14,8
7	16,2	15,6	17,1
8	18,4	17,7	19,3
9	20,6	19,8	21,6
10	22,8	21,9	23,9
11	24,9	23,9	
12			

P. P.

48°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

42°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	′
0	9.82 551		9.95 444		0.04 556	9.87 107		60
1	9.82 565	14	9.95 469	25	0.04 531	9.87 096	11	59
2	9.82 579	14	9.95 495	26	0.04 505	9.87 085	11	58
3	9.82 593	14	9.95 520	25	0.04 480	9.87 073	12	57
4	9.82 607	14	9.95 545	25	0.04 455	9.87 062	11	56
5	9.82 621	14	9.95 571	26	0.04 429	9.87 050	12	55
6	9.82 635	14	9.95 596	25	0.04 404	9.87 039	11	54
7	9.82 649	14	9.95 622	26	0.04 378	9.87 028	11	53
8	9.82 663	14	9.95 647	25	0.04 353	9.87 016	12	52
9	9.82 677	14	9.95 672	25	0.04 328	9.87 005	11	51
10	9.82 691	14	9.95 698	26	0.04 302	9.86 993	12	50
11	9.82 705	14	9.95 723	25	0.04 277	9.86 982	11	49
12	9.82 719	14	9.95 748	25	0.04 252	9.86 970	12	48
13	9.82 733	14	9.95 774	26	0.04 226	9.86 959	11	47
14	9.82 747	14	9.95 799	25	0.04 201	9.86 947	12	46
15	9.82 761	14	9.95 825	26	0.04 175	9.86 936	11	45
16	9.82 775	14	9.95 850	25	0.04 150	9.86 924	12	44
17	9.82 788	13	9.95 875	25	0.04 125	9.86 913	11	43
18	9.82 802	14	9.95 901	26	0.04 099	9.86 902	11	42
19	9.82 816	14	9.95 926	25	0.04 074	9.86 890	12	41
20	9.82 830	14	9.95 952	26	0.04 048	9.86 879	11	40
21	9.82 844	14	9.95 977	25	0.04 023	9.86 867	12	39
22	9.82 858	14	9.96 002	25	0.03 998	9.86 855	12	38
23	9.82 872	14	9.96 028	26	0.03 972	9.86 844	11	37
24	9.82 885	13	9.96 053	25	0.03 947	9.86 832	12	36
25	9.82 899	14	9.96 078	25	0.03 922	9.86 821	11	35
26	9.82 913	14	9.96 104	26	0.03 896	9.86 809	12	34
27	9.82 927	14	9.96 129	25	0.03 871	9.86 798	11	33
28	9.82 941	14	9.96 155	26	0.03 845	9.86 786	12	32
29	9.82 955	14	9.96 180	25	0.03 820	9.86 775	11	31
30	9.82 968	13	9.96 205	25	0.03 795	9.86 763	12	30
31	9.82 982	14	9.96 231	26	0.03 769	9.86 752	11	29
32	9.82 996	14	9.96 256	25	0.03 744	9.86 740	12	28
33	9.83 010	14	9.96 281	25	0.03 719	9.86 728	12	27
34	9.83 023	13	9.96 307	26	0.03 693	9.86 717	11	26
35	9.83 037	14	9.96 332	25	0.03 668	9.86 705	12	25
36	9.83 051	14	9.96 357	25	0.03 643	9.86 694	11	24
37	9.83 065	14	9.96 383	26	0.03 617	9.86 682	12	23
38	9.83 078	13	9.96 408	25	0.03 592	9.86 670	12	22
39	9.83 092	14	9.96 433	25	0.03 567	9.86 659	11	21
40	9.83 106	14	9.96 459	26	0.03 541	9.86 647	12	20
41	9.83 120	14	9.96 484	25	0.03 516	9.86 635	12	19
42	9.83 133	13	9.96 510	26	0.03 490	9.86 624	11	18
43	9.83 147	14	9.96 535	25	0.03 465	9.86 612	12	17
44	9.83 161	14	9.96 560	25	0.03 440	9.86 600	12	16
45	9.83 174	13	9.96 586	26	0.03 414	9.86 589	11	15
46	9.83 188	14	9.96 611	25	0.03 389	9.86 577	12	14
47	9.83 202	14	9.96 636	25	0.03 364	9.86 565	12	13
48	9.83 215	13	9.96 662	26	0.03 338	9.86 554	11	12
49	9.83 229	14	9.96 687	25	0.03 313	9.86 542	12	11
50	9.83 242	13	9.96 712	25	0.03 288	9.86 530	12	10
51	9.83 256	14	9.96 738	26	0.03 262	9.86 518	12	9
52	9.83 270	14	9.96 763	25	0.03 237	9.86 507	11	8
53	9.83 283	13	9.96 788	25	0.03 212	9.86 495	12	7
54	9.83 297	14	9.96 814	26	0.03 186	9.86 483	12	6
55	9.83 310	13	9.96 839	25	0.03 161	9.86 472	11	5
56	9.83 324	14	9.96 864	25	0.03 136	9.86 460	12	4
57	9.83 338	14	9.95 890	26	0.03 110	9.86 448	12	3
58	9.83 351	13	9.96 915	25	0.03 085	9.86 436	12	2
59	9.83 365	14	9.96 940	25	0.03 060	9.86 425	11	1
60	9.83 378	13	9.96 966	26	0.03 034	9.86 413	12	0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	26	25
1	0,4	0,4
2	0,9	0,8
3	1,3	1,2
4	1,7	1,7
5	2,2	2,1
6	2,6	2,5
7	3,0	2,9
8	3,5	3,3
9	3,9	3,8
10	4,3	4,2
20	8,7	8,3
30	13,0	12,5
40	17,3	16,7
50	21,7	20,8

	14	13
1	0,2	0,2
2	0,5	0,4
3	0,7	0,6
4	0,9	0,9
5	1,2	1,1
6	1,4	1,3
7	1,6	1,5
8	1,9	1,7
9	2,1	2,0
10	2,3	2,2
20	4,7	4,3
30	7,0	6,5
40	9,3	8,7
50	11,7	10,8

	12	11
1	0,2	0,2
2	0,4	0,4
3	0,6	0,6
4	0,8	0,7
5	1,0	0,9
6	1,2	1,1
7	1,4	1,3
8	1,6	1,5
9	1,8	1'6
10	2,0	1,8
20	4,0	3,7
30	6,0	5,5
40	8,0	7,3
50	10,0	9,2

	12/26	11/26	11/25
0	1,1	1,2	1,1
1	3,2	3,5	3,4
2	5,4	5,9	5,7
3	7,6	8,3	7,9
4	9,8	10,6	10,2
5	11,9	13,0	12,5
6	14,1	15,4	14,8
7	16,2	17,7	17,1
8	18,4	20,1	19,3
9	20,6	22,5	21,6
10	22,8	24,8	23,9
11	24,9	—	—
12			

P. P.

47°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

43°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.83 378	14	9.96 966	25	0.03 034	9.86 413	12	60
1	9.83 392	13	9.96 991	25	0.03 009	9.86 401	12	59
2	9.83 405	14	9.97 016	26	0.02 984	9.86 389	12	58
3	9.83 419	13	9.97 042	25	0.02 958	9.86 377	11	57
4	9.83 432	14	9.97 067	25	0.02 933	9.86 366	12	56
5	9.83 446	13	9.97 092	26	0.02 908	9.86 354	12	55
6	9.83 459	14	9.97 118	25	0.02 882	9.86 342	12	54
7	9.83 473	13	9.97 143	25	0.02 857	9.86 330	12	53
8	9.83 486	14	9.97 168	25	0.02 832	9.86 318	12	52
9	9.83 500	13	9.97 193	26	0.02 807	9.86 306	11	51
10	9.83 513	14	9.97 219	25	0.02 781	9.86 295	12	50
11	9.83 527	13	9.97 244	25	0.02 756	9.86 283	12	49
12	9.83 540	14	9.97 269	26	0.02 731	9.86 271	12	48
13	9.83 554	13	9.97 295	25	0.02 705	9.86 259	12	47
14	9.83 567	14	9.97 320	25	0.02 680	9.86 247	12	46
15	9.83 581	13	9.97 345	26	0.02 655	9.86 235	12	45
16	9.83 594	14	9.97 371	25	0.02 629	9.86 223	12	44
17	9.83 608	13	9.97 396	25	0.02 604	9.86 211	11	43
18	9.83 621	13	9.97 421	26	0.02 579	9.86 200	12	42
19	9.83 634	14	9.97 447	25	0.02 553	9.86 188	12	41
20	9.83 648	13	9.97 472	25	0.02 528	9.86 176	12	40
21	9.83 661	13	9.97 497	26	0.02 503	9.86 164	12	39
22	9.83 674	14	9.97 523	25	0.02 477	9.86 152	12	38
23	9.83 688	13	9.97 548	25	0.02 452	9.86 140	12	37
24	9.83 701	14	9.97 573	25	0.02 427	9.86 128	12	36
25	9.83 715	13	9.97 598	26	0.02 402	9.86 116	12	35
26	9.83 728	13	9.97 624	25	0.02 376	9.86 104	12	34
27	9.83 741	14	9.97 649	25	0.02 351	9.86 092	12	33
28	9.83 755	13	9.97 674	26	0.02 326	9.86 080	12	32
29	9.83 768	13	9.97 700	25	0.02 300	9.86 068	12	31
30	9.83 781	14	9.97 725	25	0.02 275	9.86 056	12	30
31	9.83 795	13	9.97 750	26	0.02 250	9.86 044	12	29
32	9.83 808	13	9.97 776	25	0.02 224	9.86 032	12	28
33	9.83 821	13	9.97 801	25	0.02 199	9.86 020	12	27
34	9.83 834	14	9.97 826	25	0.02 174	9.86 008	12	26
35	9.83 848	13	9.97 851	26	0.02 149	9.85 996	12	25
36	9.83 861	13	9.97 877	25	0.02 123	9.85 984	12	24
37	9.83 874	13	9.97 902	25	0.02 098	9.85 972	12	23
38	9.83 887	14	9.97 927	26	0.02 073	9.85 960	12	22
39	9.83 901	13	9.97 953	25	0.02 047	9.85 948	12	21
40	9.83 914	13	9.97 978	25	0.02 022	9.85 936	12	20
41	9.83 927	13	9.98 003	26	0.01 997	9.85 924	12	19
42	9.83 940	14	9.98 029	25	0.01 971	9.85 912	12	18
43	9.83 954	13	9.98 054	25	0.01 946	9.85 900	12	17
44	9.83 967	13	9.98 079	25	0.01 921	9.85 888	12	16
45	9.83 980	13	9.98 104	26	0.01 896	9.85 876	12	15
46	9.83 993	13	9.98 130	25	0.01 870	9.85 864	13	14
47	9.84 006	14	9.98 155	25	0.01 845	9.85 851	12	13
48	9.84 020	13	9.98 180	26	0.01 820	9.85 839	12	12
49	9.84 033	13	9.98 206	25	0.01 794	9.85 827	12	11
50	9.84 046	13	9.98 231	25	0.01 769	9.85 815	12	10
51	9.84 059	13	9.98 256	25	0.01 744	9.85 803	12	9
52	9.84 072	13	9.98 281	26	0.01 719	9.85 791	12	8
53	9.84 085	13	9.98 307	25	0.01 693	9.85 779	13	7
54	9.84 098	14	9.98 332	25	0.01 668	9.85 766	12	6
55	9.84 112	13	9.98 357	26	0.01 643	9.85 754	12	5
56	9.84 125	13	9.98 383	25	0.01 617	9.85 742	12	4
57	9.84 138	13	9.98 408	25	0.01 592	9.85 730	12	3
58	9.84 151	13	9.98 433	25	0.01 567	9.85 718	12	2
59	9.84 164	13	9.98 458	26	0.01 542	9.85 706	13	1
60	9.84 177		9.98 484		0.01 516	9.85 693		0
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	26	25
1	0,4	0,4
2	0,9	0,8
3	1,3	1,2
4	1,7	1,7
5	2,2	2,1
6	2,6	2,5
7	3,0	2,9
8	3,5	3,3
9	3,9	3,8
10	4,3	4,2
20	8,7	8,3
30	13,0	12,5
40	17,3	16,7
50	21,7	20,8

	14	13
1	0,2	0,2
2	0,5	0,4
3	0,7	0,6
4	0,9	0,9
5	1,2	1,1
6	1,4	1,3
7	1,6	1,5
8	1,9	1,7
9	2,1	2,0
10	2,3	2,2
20	4,7	4,3
30	7,0	6,5
40	9,3	8,7
50	11,7	10,8

	12	11
1	0,2	0,2
2	0,4	0,4
3	0,6	0,6
4	0,8	0,7
5	1,0	0,9
6	1,2	1,1
7	1,4	1,3
8	1,6	1,5
9	1,8	1,6
10	2,0	1,8
20	4,0	3,7
30	6,0	5,5
40	8,0	7,3
50	10,0	9,2

	13 — 26	13 — 25	12 — 25
0	1,0	0,9	1,1
1	3,0	2,9	3,1
2	5,0	4,8	5,2
3	7,0	6,7	7,3
4	9,0	8,7	9,4
5	11,0	10,6	11,5
6	13,0	12,5	13,5
7	15,0	14,4	15,6
8	17,0	16,3	17,7
9	19,0	18,3	19,8
10	21,0	20,2	21,9
11	23,0	22,1	23,9
12	25,0	24,1	—
13			

P. P.

46°

TABLE XXXVI.—*Logarithmic sines, cosines, tangents, and cotangents*—Continued.

[Extracted from Gauss' Logarithmic and Trigonometric Tables.]

44°

′	L. Sin.	d.	L. Tang.	d. c.	L. Cotg.	L. Cos.	d.	
0	9.84 177		9.98 484		0.01 516	9.85 693		**60**
1	9.84 190	13	9.98 509	25	0.01 491	9.85 681	12	59
2	9.84 203	13	9.98 534	25	0.01 466	9.85 669	12	58
3	9.84 216	13	9.98 560	26	0.01 440	9.85 657	12	57
4	9.84 229	13	9.98 585	25	0.01 415	9.85 645	12	56
5	9.84 242	13	9.98 610	25	0.01 390	9.85 632	13	55
6	9.84 255	13	9.98 635	25	0.01 365	9.85 620	12	54
7	9.84 269	14	9.98 661	26	0.01 339	9.85 608	12	53
8	9.84 282	13	9.98 686	25	0.01 314	9.85 596	12	52
9	9.84 295	13	9.98 711	25	0.01 289	9.85 583	13	51
10	9.84 308	13	9.98 737	26	0.01 263	9.85 571	12	**50**
11	9.84 321	13	9.98 762	25	0.01 238	9.85 559	12	49
12	9.84 334	13	9.98 787	25	0.01 213	9.85 547	12	48
13	9.84 347	13	9.98 812	25	0.01 188	9.85 534	13	47
14	9.84 360	13	9.98 838	26	0.01 162	9.85 522	12	46
15	9.84 373	13	9.98 863	25	0.01 137	9.85 510	12	45
16	9.84 385	12	9.98 888	25	0.01 112	9.85 497	13	44
17	9.84 398	13	9.98 913	25	0.01 087	9.85 485	12	43
18	9.84 411	13	9.98 939	26	0.01 061	9.85 473	12	42
19	9.84 424	13	9.98 964	25	0.01 036	9.85 460	13	41
20	9.84 437	13	9.98 989	25	0.01 011	9.85 448	12	**40**
21	9.84 450	13	9.99 015	26	0.00 985	9.85 436	12	39
22	9.84 463	13	9.99 040	25	0.00 960	9.85 423	13	38
23	9.84 476	13	9.99 065	25	0.00 935	9.85 411	12	37
24	9.84 489	13	9.99 090	25	0.00 910	9.85 399	12	36
25	9.84 502	13	9.99 116	26	0.00 884	9.85 386	13	35
26	9.84 515	13	9.99 141	25	0.00 859	9.85 374	12	34
27	9.84 528	13	9.99 166	25	0.00 834	9.85 361	13	33
28	9.84 540	12	9.99 191	25	0.00 809	9.85 349	12	32
29	9.84 553	13	9.99 217	26	0.00 783	9.85 337	12	31
30	9.84 566	13	9.99 242	25	0.00 758	9.85 324	13	**30**
31	9.84 579	13	9.99 267	25	0.00 733	9.85 312	12	29
32	9.84 592	13	9.99 293	26	0.00 707	9.85 299	13	28
33	9.84 605	13	9.99 318	25	0.00 682	9.85 287	12	27
34	9.84 618	13	9.99 343	25	0.00 657	9.85 274	13	26
35	9.84 630	12	9.99 368	25	0.00 632	9.85 262	12	25
36	9.84 643	13	9.99 394	26	0.00 606	9.85 250	12	24
37	9.84 656	13	9.99 419	25	0.00 581	9.85 237	13	23
38	9.84 669	13	9.99 444	25	0.00 556	9.85 225	12	22
39	9.84 682	13	9.99 469	25	0.00 531	9.85 212	13	21
40	9.84 694	12	9.99 495	26	0.00 505	9.85 200	12	**20**
41	9.84 707	13	9.99 520	25	0.00 480	9.85 187	13	19
42	9.84 720	13	9.99 545	25	0.00 455	9.85 175	12	18
43	9.84 733	13	9.99 570	25	0.00 430	9.85 162	13	17
44	9.84 745	12	9.99 596	26	0.00 404	9.85 150	12	16
45	9.84 758	13	9.99 621	25	0.00 379	9.85 137	13	15
46	9.84 771	13	9.99 646	25	0.00 354	9.85 125	12	14
47	9.84 784	13	9.99 672	26	0.00 328	9.85 112	13	13
48	9.84 796	12	9.99 697	25	0.00 303	9.85 100	12	12
49	9.84 809	13	9.99 722	25	0.00 278	9.85 087	13	11
50	9.84 822	13	9.99 747	25	0.00 253	9.85 074	13	**10**
51	9.84 835	13	9.99 773	26	0.00 227	9.85 062	12	9
52	9.84 847	12	9.99 798	25	0.00 202	9.85 049	13	8
53	9.84 860	13	9.99 823	25	0.00 177	9.85 037	12	7
54	9.84 873	13	9.99 848	25	0.00 152	9.85 024	13	6
55	9.84 885	12	9.99 874	26	0.00 126	9.85 012	12	5
56	9.84 898	13	9.99 899	25	0.00 101	9.84 999	13	4
57	9.84 911	13	9.99 924	25	0.00 076	9.84 986	13	3
58	9.84 923	12	9.99 949	25	0.00 051	9.84 974	12	2
59	9.84 936	13	9.99 975	26	0.00 025	9.84 961	13	1
60	9.84 949	13	0.00 000	25	0.00 000	9.84 949	12	**0**
	L. Cos.	d.	L. Cotg.	d. c.	L. Tang.	L. Sin.	d.	′

P. P.

	26	**25**
1	0,4	0,4
2	0,9	0,8
4	1,3	1,2
3	1,7	1,7
5	2,2	2,1
6	2,6	2,5
7	3,0	2,9
8	3,5	3,3
9	3,9	3,8
10	4,3	4,2
20	8,7	8,3
30	13,0	12,5
40	17,3	16,7
50	21,7	20,8

	14	**13**	**12**
1	0,2	0,2	0,2
2	0,5	0,4	0,4
3	0,7	0,6	0,6
4	0,9	0,9	0,8
5	1,2	1,1	1,0
6	1,4	1,3	1,2
7	1,6	1,5	1,4
8	1,9	1,7	1,6
9	2,1	2,0	1,8
10	2,3	2,2	2,0
20	4,7	4,3	4,0
30	7,0	6,5	6,0
40	9,3	8,7	8,0
50	11,7	10,8	10,0

	$\frac{13}{26}$	$\frac{13}{25}$
0	1,0	0,9
1	3,0	2,9
2	5,0	4,8
3	7,0	6,7
4	9,0	8,7
5	11,0	10,6
6	13,0	12,5
7	15,0	14,4
8	17,0	16,3
9	19,0	18,3
10	21,0	20,2
11	23,0	22,1
12	25,0	24,1
13		

	$\frac{12}{26}$	$\frac{12}{25}$
0	1,1	1,0
1	3,2	3,1
2	5,4	5,2
3	7,6	7,3
4	9,8	9,4
5	11,9	11,5
6	14,1	13,5
7	16,2	15,6
8	18,4	17,7
9	20,6	19,8
10	22,8	21,9
11	24,9	23,9
12		

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45°

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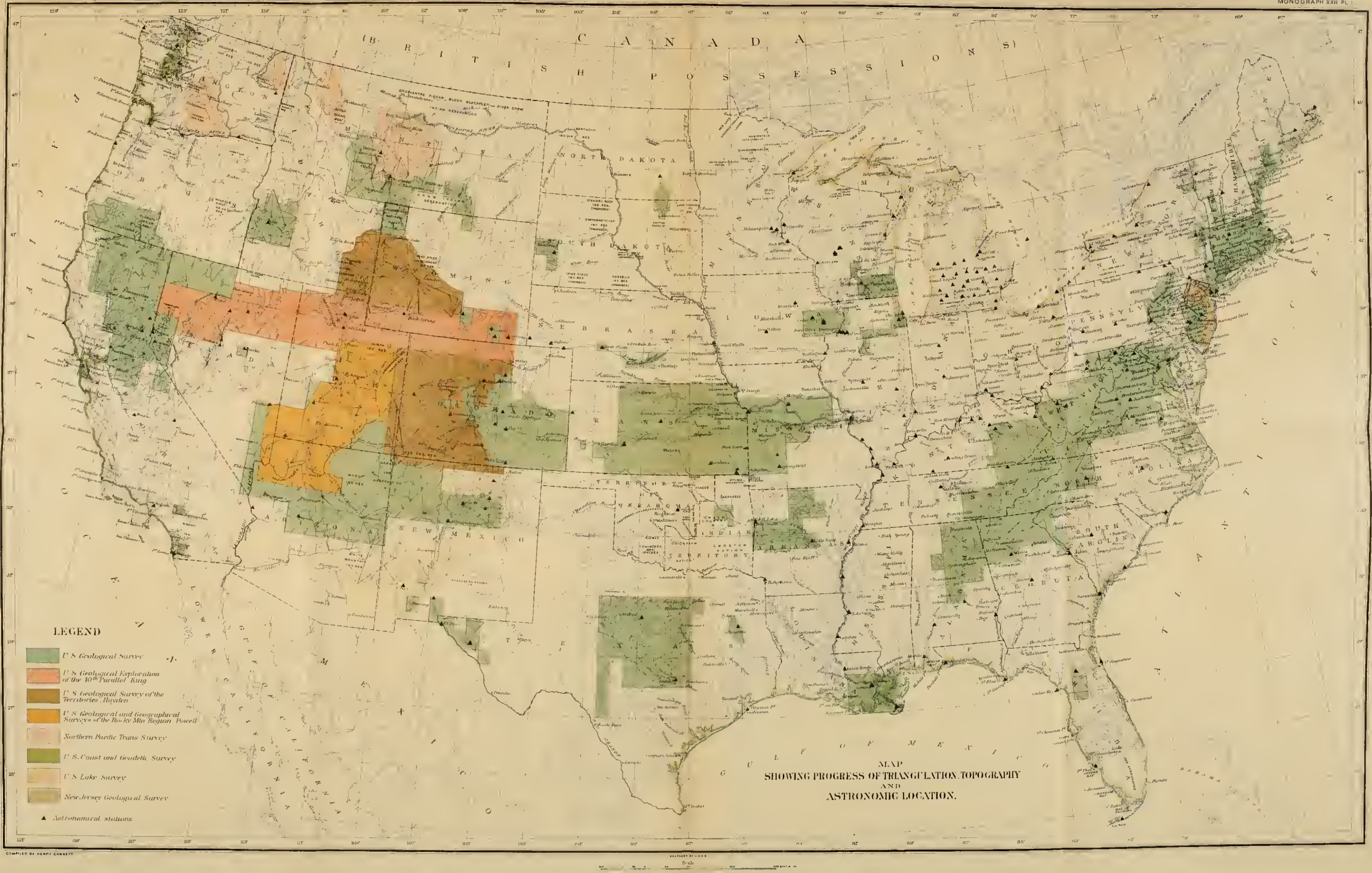
CANADA
(BRITISH POSSESSIONS)
PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF MEXICO
LOWER CALIFORNIA
WASHINGTON
OREGON
MONTANA
NORTH DAKOTA
SOUTH DAKOTA
WYOMING
NEBRASKA
IOWA
MICHIGAN
PENNSYLVANIA
NEW YORK
NEW HAMPSHIRE
MASSACHUSETTS
COLORADO
KANSAS
MISSOURI
KENTUCKY
WEST VIRGINIA
ARIZONA
NEW MEXICO
INDIAN TERRITORY
ARKANSAS
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
TEXAS
LEGEND
U S Geological Survey
U S Geological Exploration of the 40th Parallel King
U S Geological Survey of the Territories Hayden
U S Geological and Geographical Surveys of the Rocky Mtn Region Powell
Northern Pacific Trans Survey
U S Coast and Geodetic Survey
U S Lake Survey
New Jersey Geological Survey
▲ Astronomical stations
Scale

MAP
SHOWING PROGRESS OF TRIANGULATION, TOPOGRAPHY
AND
ASTRONOMIC LOCATION.

COMPILED BY HENRY GANNETT